# Gude Landfill
# Nature and Extent Study Report
# Montgomery County, Maryland

*Prepared for:*

Department of Environmental Protection
Division of Solid Waste Services
Montgomery County, Maryland

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ATC | Anticipated Typical Concentration |
| | |
| bgs | Below Ground Surface |
| BTAG | Biological Technical Assistance Group |
| | |
| CFR | Code of Federal Regulations |
| CGI | Combustible Gas Indicator |
| COC | Contaminant of Concern |
| COMAR | Code of Maryland Regulations |
| COPC | Constituent of Potential Concern |
| CPI | Central Plants, Inc. |
| CSM | Conceptual Site Model |
| | |
| DEP | Department of Environmental Protection |
| DHMH | Department of Health and Mental Hygiene |
| DPW | Department of Public Works |
| DPWT | Department of Public Works and Transportation |
| DSWS | Division of Solid Waste Services |
| | |
| EA | EA Engineering, Science, and Technology, Inc. |
| EcoSSLs | Ecological Soil Screening Levels |
| EPA | U.S. Environmental Protection Agency |
| | |
| ft | Foot or Feet |
| FOD | Frequency of Detection |
| | |
| GLCC | Gude Landfill Concerned Citizens |
| | |
| HOA | Home Owners Association |
| HPAH | High Molecular Weight Polycyclic Aromatic Hydrocarbon |
| HQ | Hazard Quotient |
| | |
| in. | Inch(es) |
| | |
| J&E | Johnson and Ettinger |
| | |
| LEL | Lower Explosive Limit |
| LFGE | Landfill Gas to Energy |

## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

| | |
|---|---|
| MCL | Maximum Contaminant Level |
| MD-DNR | Maryland Department of Natural Resources |
| MDE | Maryland Department of the Environment |
| mg/kg | Milligrams Per Kilogram (equal to parts per million, ppm) |
| MHT | Maryland Historical Trust |
| M-NCPPC | Maryland-National Capital Park and Planning Commission |
| MSWLF | Municipal Solid Waste Landfill |
| NMWDA | Northeast Maryland Waste Disposal Authority |
| NPDES | National Pollutant Discharge Elimination System |
| PCB | Polychlorinated Biphenyl |
| PCE | Tetrachloroethene |
| PID | Photoionization Detector |
| PQL | Practical Quantitation Limit |
| ppb | Parts Per Billion |
| PVC | Polyvinyl Chloride |
| RAGS | Risk Assessment Guidance for Superfund |
| RBC | Risk-Based Concentration |
| RCRA | Resource Conservation and Recovery Act |
| RSL | Regional Screening Level |
| SCS | SCS Engineers |
| SDWA | Safe Drinking Water Act |
| SQL | Sample Quantitation Level |
| SVOC | Semivolatile Organic Compound |
| SWPPP | Stormwater Pollution Prevention Plan |
| TCE | Trichloroethene |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| VOC | Volatile Organic Compound |
| WSSC | Washington Suburban Sanitary Commission |
| µg/L | Microgram(s) Per Liter (equal to parts per billion, ppb) |

## EXECUTIVE SUMMARY

The Montgomery County (the County) Department of Environmental Protection (DEP) was directed by the Maryland Department of the Environment (MDE) to conduct a Nature and Extent Study of environmental impacts in the vicinity of and potentially resulting from the Gude Landfill (the Landfill). The purpose of the study was to characterize the nature and extent of potential Landfill impacts on groundwater, surface water, and surface and subsurface soils, and to conduct hydrogeologic and fate and transport assessments.

The Landfill, located at 600 East Gude Drive in Rockville, Maryland, is the oldest formal landfill in Montgomery County, and was used for the disposal of municipal solid waste and incinerator residues from 1964 and 1982. The site encompasses approximately one hundred sixty-two (162) acres, of which approximately one hundred (100) acres were used for waste disposal. The Landfill is currently owned and maintained by the County DEP, Division of Solid Waste Services (DSWS). The surrounding area is mixed use, with the Landfill bounded to the south by industrial operations, to the west/northwest by the Derwood Station residential development, and to the north and east by Maryland-National Capital Park and Planning Commission (M-NCPPC) property. The Landfill was constructed before current design and closure standards were implemented by the U.S. Environmental Protection Agency (EPA), under the Resource Conservation and Recovery Act (RCRA); therefore, it does not have a bottom liner system or a synthetic cap system. Approximately two (2) feet (ft) of soil cover was reportedly placed on the Landfill surface in the 1980s. The site currently consists generally of open grassy fields with sporadic patches of trees.

The geology of the site includes unconsolidated material consisting of interbedded silts and clays near the surface at the Landfill, underlain by crystalline rock that composes a regional aquifer. The aquifer is not used as a potable water supply in the vicinity of the Landfill. The groundwater table is typically present in the unconsolidated sediments along the perimeter of the Landfill and under the Derwood Station residential development at depths ranging from three (3) to sixty (60) ft below ground surface. Twenty (20) groundwater monitoring wells were installed historically at the site. These groundwater monitoring wells, along with five (5) surface water locations, have been sampled and analyzed from 1984 to the present under DEP's Water Quality Monitoring Program. Sixteen (16) additional groundwater monitoring wells were installed as part of this Nature and Extent Study. A Groundwater and Surface Water Monitoring Plan approved by MDE in 2009 is currently in place at the site. Under this plan, groundwater and surface water are sampled and reported to MDE semiannually (in April and September).

Historical groundwater sampling events reported concentrations of several volatile organic compounds (VOCs) consistently exceeding maximum contaminant levels (MCLs), established by the EPA, in one (1) or more monitoring wells. VOCs identified as contaminants of concern (COCs) at the Landfill, based on consistent exceedances, are tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene, vinyl chloride, benzene, methylene chloride, and 1,2-dichloropropane. However, of the more than thirteen thousand (13,000) constituents analyzed from all surface water samples collected historically (May 2001 to September 2010) in streams near the Landfill, thirteen (13) exceedances of MCLs have been reported.

This Nature and Extent Study included reviews of the existing stormwater infrastructure, the landfill gas management system, and leachate seep management. A Limit of Waste Delineation, Aerial Mapping and Field Surveys, and Protected Resource Investigations were also performed in conjunction with this Study. The waste delineation study, conducted in 2009, confirmed that waste was generally placed within the Landfill property boundary except along the northeastern landfill boundary. Along this boundary, waste was identified two hundred (200) to two hundred fifty (250) ft northeast of the northeastern property boundary, on M-NCPPC property.

Groundwater elevation data were collected from all twenty (20) preexisting groundwater monitoring wells and sixteen (16) newly installed monitoring wells during the Nature and Extent Study. These data indicate easterly and southerly groundwater flow with minor flow components to the north and northeast in the northern portions of the site. These components appear to reflect a radial groundwater flow regime around the edges of the Landfill, which may be the result of topographic relief and surface water infiltration variations created by the former landfill.

Groundwater samples were collected from thirty-six (36) monitoring wells as part of this Nature and Extent Study. Consistent with historical reports, the highest VOC concentrations generally were reported for samples taken along the north-northwestern and south-central boundaries of the Landfill. Generally, COC concentrations, except vinyl chloride, were less than MCLs in the southwest, southeast, and northeast portions of the site. Analytical data indicate that the impacts present in groundwater monitoring wells OB03 and OB03A appear to extend north to MW-13A and MW-13B, not west toward the Derwood Station residential development. Of the more than sixty-one thousand (61,000) constituents analyzed from all groundwater samples collected historically (April 2001 to September 2010) from the twenty (20) existing groundwater monitoring wells at the Landfill, six hundred forty-eight (648) exceedances of MCLs have been reported.

Surface water samples were collected from the five (5) previously sampled locations, along with five (5) additional sampling locations. These samples were collected from streams located north, east, and south of the Landfill. Only one (1) exceedance of MDE Cleanup Standards for Groundwater was reported, for cobalt, in a small drainage channel northeast of the Landfill.

Subsurface soil samples were collected from borings during groundwater monitoring well construction, and surface soil grab samples were collected from eleven (11) locations along the northwestern boundary of the site, to assess the condition of soil along the Derwood Station residential development property boundary, near the men's shelter, and near the model airplane flying area. The reported concentrations of arsenic, chromium, cobalt, and vanadium exceeded MDE Residential Cleanup Standards for Soil, but are consistent with typical background concentrations published by MDE. Two (2) polychlorinated biphenyl (PCB) exceedances were also reported, one (1) each in the surface and subsurface soils.

A human health risk evaluation was performed in accordance with MDE and EPA guidance (MDE 2008, EPA 2010, EPA 1989), using the analytical data. The risk evaluation identified no human health concerns related to contact with surface water or soils, or related to indoor air inhalation following vapor intrusion from groundwater. The only potential human health concern identified related to groundwater would arise if the aquifer were used as a potable water supply. However, the aquifer is not used as a potable water supply in nearby residential areas, due to the availability of a public water supply via the Washington Suburban Sanitary Commission (WSSC). Therefore, this is currently an incomplete exposure pathway. For surface and subsurface soils, reported metals concentrations are consistent with MDE-published background levels, and do not present human health concerns. The isolated detections of PCBs in surface and subsurface soils indicate that there is not a site-wide PCB concern and that PCBs in soil are not likely to result in human health concerns at the site.

An ecological risk evaluation performed using the analytical data identified potentially complete pathways between ecological receptors, including terrestrial and aquatic organisms, and surface soil and surface water. As with the human health risk evaluation, the ecological screening concluded that terrestrial receptors exposed to surface soils are not at risk, because the concentrations of metal and high molecular weight polycyclic aromatic hydrocarbon (HPAH) constituents of potential concern in the surface soil are consistent with reference or natural conditions. Isolated occurrences of metals at concentrations exceeding MDE cleanup standards in surface water also are do not present a risk to populations of aquatic organisms.

The primary findings of this study include the following:

- Groundwater flow around the Landfill is to the east and south, with minor flow components to the north and northeast in the northern portions of the site.

- Consistent with historical reports, the highest VOC concentrations in groundwater, including multiple MCL exceedances, were reported for samples collected along the north-northwestern and south-central boundaries of the Landfill.

- One (1) exceedance of MDE Cleanup Standards for Groundwater was reported in surface water, for cobalt, in a small drainage area northeast of the Landfill. This single isolated exceedance is consistent with the occasional, isolated exceedances reported during historical surface water sampling events.

- The reported concentrations of arsenic, chromium, cobalt, and vanadium exceeded MDE Residential Cleanup Standards for Soil, but are consistent with typical background concentrations published by MDE. Two (2) PCB exceedances were also reported, one (1) each in the surface and subsurface soils.

- The only potential human health concern identified related to groundwater would arise if the aquifer were used as a potable water supply; however, this is currently an incomplete exposure pathway due to the availability of a public water supply in nearby communities.

- The isolated detections of PCBs in surface and subsurface soils indicate that there is not a site-wide PCB concern and that PCBs in soil are not likely to result in human health concerns at the site.

- For surface and subsurface soils, reported metals and HPAH concentrations are consistent with reference concentrations or MDE-published background levels, and do not present ecological or human health concerns.

# 1. INTRODUCTION

## 1.1 PURPOSE

The Montgomery County (the County) Department of Environmental Protection (DEP) was directed by the Maryland Department of the Environment (MDE) to conduct a Nature and Extent Study of environmental impacts in the vicinity of and potentially resulting from the Gude Landfill (the Landfill). The Nature and Extent Study occurred in sequenced phases:

- Phase 0 – The scope of work included aerial mapping, field survey, and a limit of waste delineation investigation. This work provided visual mapping (aerial photography) of the entire Landfill; established the property boundary of the Landfill; established survey control for all existing infrastructure of the Landfill; and determined the limit of waste placement along the perimeter boundary of the Landfill. Phase 0 work was addressed under separate cover to MDE and is summarized in subsequent sections of the Nature and Extent Study Report.

- Phase 1 – The scope of work included completion of a Nature and Extent Study. Specifically, the work included a characterization of the existing conditions at the Landfill and an investigation of the nature and extent of potential environmental impacts from the Landfill. Phase 1 work is detailed herein, in the Nature and Extent Study Report.

Following review of the Nature and Extent Study and associated results, MDE and the Montgomery County DEP will evaluate remediation alternatives. Upon agreement, the County will implement the chosen remediation alternative(s) in accordance with the MDE established remediation goals:

- No exceedances of maximum contaminant levels (MCLs), established by the U.S. Environmental Protection Agency (EPA) as limits for drinking water, in the groundwater at the Landfill property boundary or between the Landfill and adjacent streams.

- No non-stormwater discharges to the waters of the State.

- No lower explosive limit (LEL) exceedances for methane at the Landfill property boundary.

Concurrent with the remediation effort, representatives from MDE, the County, and the community will work together to establish preferred land reuses for the Landfill.

## 1.2 LANDFILL HISTORY

The Gude Landfill is the oldest formal landfill in Montgomery County (the County). The Landfill was used for the disposal of municipal solid waste and incinerator residues from 1964 to 1982. The site encompasses approximately one hundred sixty-two (162) acres, of which approximately one hundred (100) acres were used for waste disposal. The Landfill is currently owned and maintained by the County DEP, Division of Solid Waste Services (DSWS). The Landfill is located on the northern side of East Gude Drive and extends to the northern side of Southlawn Lane with the primary entrance point at 600 East Gude Drive in Rockville, Maryland.

In 1963, the Montgomery County Council was permitted under Refuse Disposal Permit No. 63-32-0506 to operate an incinerator at the Gude-Southlawn Landfill, which was located off of the Southlawn Lane site entrance. The Landfill was constructed before current design standards for liners and caps were in place; therefore, no bottom liner system was installed. Waste disposal at the landfill site during that period primarily consisted of incinerator residues (ashes) except during periods of incinerator downtime and waste stream overflows. The incinerator ceased operation in 1970. Due to lack of capacity at the existing landfill site, the County placed waste in a ravine adjacent to the landfill site from 1970 to 1972.

On 22 February 1973, Refuse Disposal Permit No. 73-15-04-02A was issued to the County Department of Public Works (DPW) for the construction and operation of the Central Sanitary Landfill on forty-three and nine-tenths (43.9) acres of property adjacent to and west of the Gude-Southlawn Landfill. On 2 December 1977, due to the exhaustion of waste disposal capacity at the Central Sanitary Landfill, the Maryland Department of Health and Mental Hygiene (DHMH) issued an Emergency Health Order to the County. The Order required the County to submit a permit application to DHMH and redesign the Central Sanitary Landfill to allow for waste disposal through 1 July 1981. The Order also directed the County to obtain all necessary permits and place into operation one (1) or more landfill sites approved by DHMH prior to the date when the existing Central Sanitary Landfill would reach its redesigned disposal capacity. The facility names of the Central Sanitary Landfill and associated portions of the Gude-Southlawn Landfill were modified by reference to the Gude-Southlawn Landfill.

In 1979, Refuse Disposal Permit No. 79-15-04-06A was issued to the County to revise the grades and elevations of the Gude-Southlawn Landfill, thus providing waste disposal capacity through the DHMH-mandated closure date of April 1982. Also in 1979, Refuse Disposal Permit No. 79-15-01-02A was issued for the construction and operation of the new Oaks Sanitary Landfill located in Laytonsville, Maryland. On 3 June 1981, at the request of Montgomery County, DHMH modified the Order to defer the required date of transferring landfill operations from the Gude-Southlawn Landfill to the Oaks Sanitary Landfill until 1 June 1982. The Gude-Southlawn Landfill ceased operations on 30 May 1982. For approximately two (2) years, the site was covered with two (2) to five (5) feet (ft) of soil and in places with a layer of Chemfix (composted municipal waste/sludge). Soil cover on the side slopes in places may be less than two (2) ft. In 1983, the Gude-Southlawn Landfill was closed in compliance with DHMH requirements. The facility name of the Gude-Southlawn Landfill was modified by reference to the Gude Landfill.

## 1.3 REGULATORY APPLICABILITY

In accordance with the Resource Conservation and Recovery Act (RCRA), national criteria (e.g., standards) for siting, permitting, designing, constructing, operating, and closure and post-closure care of municipal solid waste landfills are set forth under Title 40 of the Code of Federal Regulations, Part 258 (40 Code of Federal Regulations [CFR] 258). Subpart A of 40 CFR 258.1(c) states that these criteria do not apply to municipal solid waste landfills that did not receive waste after 9 October 1991. The Landfill ceased waste filling operations and closed in May 1982; therefore, it is not governed by RCRA or 40 CFR 258.

Under RCRA, U.S. EPA delegates the authority to regulate solid waste management activities to state entities. The Landfill is governed by the state of Maryland under the Code of Maryland Regulations (COMAR) and as directed by MDE. COMAR Title 26, Subtitle 04, Section 7 (COMAR 26.04.07), provides regulations for solid waste management.

Although the Landfill is not currently an active landfill operating under an active Refuse Disposal Permit in Maryland, MDE has the responsibility and authority to protect the quality of the environment and public health and safety under COMAR 26.04.07.03. The primary applicable regulatory references under COMAR for the Landfill are provided below:

- ***Post-Closure Monitoring and Maintenance*** **–** includes the inspection of the cover system; notation of any surface drainage irregularities or areas experiencing erosion; notation of any surface expressions of leachate; checking the status of the monitoring wells; and associated maintenance of irregularities or problems noted during the inspection at the closed landfill under COMAR 26.04.07.22.

- ***Water Quality Protection*** – includes the routine monitoring of the quality of waters (groundwater and surface water) around and beneath the Landfill site; maximum contaminant level limitations at the Landfill site property boundary; monitoring program requirements; and analytical and reporting requirements under COMAR 26.04.07.08B(17) and 26.04.07.09F.

- ***Explosive Gas Control*** – includes the collection and monitoring for explosive gases (i.e., landfill gas – methane) at the Landfill. The concentration of explosive gases generated by the facility or landfill cannot exceed twenty-five (25) percent of the LELs for the gases in facility structures, excluding gas control or recovery system components, and the LEL for the gases at the property boundary. According to this standard, methane concentrations resulting from the presence of landfill gas in onsite structures at the Landfill cannot exceed one and a quarter (1.25) percent by volume, and methane concentrations cannot exceed five (5.00) percent by volume at the landfill property boundary per COMAR 26.04.07.03B(9). [Note – the Gude Landfill Gas-to-Energy Facility is permitted separately from the Landfill site.]

- ***Stormwater Management*** – includes the management of stormwater with respect to post-closure care maintenance of the cover and drainage systems; collection and management of stormwater discharges on and offsite; and prevention of potential stormwater pollutant (i.e., non-stormwater) discharges. Post-closure care maintenance responsibilities are referenced under COMAR 26.04.07.22. Stormwater and non-stormwater discharge inspections and requirements are referenced within the 2001 Gude Landfill Stormwater Pollution Prevention Plan (SWPPP) and COMAR 26.08.04.08. The SWPPP is updated annually and is governed under the General Discharge Permit for Stormwater Associated with Industrial Activities (Permit No. 02-SW). Future site redevelopment and construction activities at the Landfill will require compliance under the existing General Permit, the County National Pollutant Discharge Elimination System (NPDES) Permit (Permit No. MDR10, State Discharge Permit No. 09GP), and the Maryland Stormwater Management Act of 2007.

## 1.4 BEST MANAGEMENT PRACTICES AT THE LANDFILL

As previously stated, the Landfill was used for the disposal of County generated municipal solid waste and incinerator residues from 1964 to 1982. Since the Landfill predated current Subtitle D design standards per RCRA, the Landfill was not originally constructed with the following environmental control infrastructure: a bottom liner (clay or synthetic), a capping system (clay or synthetic), a leachate collection system, a landfill gas collection system, and a stormwater management system. However, cover soil was reportedly used daily during filling operations.

The Landfill property is approximately one hundred sixty-two (162) acres in size with an estimated waste disposal footprint of one hundred (100) acres (excluding approximately sixteen and a half [16.5] acres of waste encroachment on Maryland-National Capital Park and Planning Commission [M-NCPPC] property). The depth of waste varies across the site from approximately fifty-five (55) to ninety (90) ft. Total waste in place is estimated at four and eight-tenths (4.8) million tons.

Since 1982, the County has voluntarily, or through regulatory mandates, implemented and maintained the following best management practices for pre-regulatory era landfills in compliance with COMAR requirements:

- ***Cover System*** **–** In accordance with the Emergency Health Order issued by Maryland DHMH in 1977, Montgomery County implemented a closure program that included covering the final layer of waste at the Landfill with two (2) to five (5) ft of soil in 1983. The Landfill site is currently well vegetated with trees, brush, and grasses. During waste filling operations, soil was reportedly used as daily cover to reduce odors and control vectors. [Mandated 1983 – Present].

- ***Cover System: Ongoing Maintenance*** **–** Surface depressions on the Landfill are typically caused by differential settlement through natural decomposition of the waste mass. Surface depressions that contain ponding water or areas that exhibit erosion are regraded with soil to reduce infiltration, prevent sediment dispersion, and redirect runoff to existing swales and stormwater collection infrastructure. Other areas of the Landfill require additional maintenance measures that include surface oriented infiltration trenches (filter fabric, stone, and polyvinyl chloride [PVC] pipe) to collect and redirect runoff.

  Leachate seep repairs are also required to maintain the integrity of the soil cover system and prevent surface runoff of contaminants. Leachate is considered any form of precipitation that comes into contact with waste. Leachate seeps typically occur on side slopes of the Landfill where the cover system soil depth is shallow (less than two [2] ft). Leachate seeps are repaired in a manner that redirects the surface expression of leachate back into the waste mass. This procedure allows for natural attenuation of the leachate since the Landfill does not have a leachate collection system. Leachate seeps are typically repaired by installing a subsurface oriented infiltration trench that includes: excavating the surface expression (soil and waste) to an adequate depth to contain the seep; lining the trench with filter fabric; placing stone in the trench as infiltration media; covering the trench with two (2) ft minimum of soil to surface grade with seed and straw. Excavated soil and waste are transported to other areas of the Landfill site to be buried and covered with two (2) ft minimum of soil with seed and straw.

The most recent site repairs for stormwater and leachate seeps occurred in February 2009 and May-June 2010 on the Northwest and Southeast portions of the Landfill. Refer to **Appendix A** (Attachment 1, Post-Closure Care Monitoring and Maintenance Technical Memorandum) for more detailed information. [Mandated 1983 – Present].

- ***Original Landfill Gas Collection System and Gas-to-Energy Facility Installation*** **–** In 1985, Central Plants, Inc. (CPI) installed a landfill gas collection system consisting of forty-four (44) gas extraction wells and a gas-to-energy facility at the Landfill. The gas-to-energy facility produced a range of one and a half (1.5) to two and seven-tenths (2.7) megawatts of power for the next twenty (20)-year period. With receipt of the operating Contractor’s notice to terminate the gas lease agreement in November 2003 (for June 2004), landfill gas management responsibilities reverted back to the County. The gas-to-energy facility was decommissioned in 2006 and replaced with a ground flare system for continued gas management. Refer to **Appendix A** (Attachment 2, Landfill Gas Management - Chronology) for more detailed information. [Voluntary 1985 – 2006].

- ***Landfill Gas Management*** **–** The County has maintained an active landfill gas collection system at the Landfill since 1985. Following receipt of the operating Contractor’s notice to terminate the gas lease agreement at the gas-to-energy facility, the County implemented a series of administrative processes, studies, and infrastructure improvements to ensure the active collection of landfill gas starting in November 2003 to present day. An abbreviated summary list of the County’s landfill gas management measures are provided below. Refer to **Appendix A** (Attachment 2, Landfill Gas Management Memorandum) for more detailed information [Voluntary 2003-2010].

- Landfill Gas Contract Procurement – Contract for Siting, Design, Permitting, Construction Quality Assurance and System Operation and Maintenance services for a landfill gas management system in January/February 2004.

- Landfill Gas Flare Station Procurement – Contract for the manufacturing and delivery of an Enclosed Gas Flare, Blower, and Control Panel Equipment System in November 2003-May 2004.

- Landfill Gas Migration Evaluation – Evaluate offsite gas migration beyond the northwest property boundary of the Landfill in June/July 2004. Through field measurements, the evaluation confirmed methane gas concentrations exceeded the five (5.00) percent threshold limit at the property boundary.

- Landfill Gas Migration Assessment – Evaluate the extent of offsite gas migration. Through the use of twenty (20) temporary gas monitoring wells installed approximately one hundred fifty (150) to two hundred (200) ft beyond the landfill property boundary near the Derwood Station Community; methane gas was detected in a group of six (6) temporary monitoring wells (#3-8) in April 2005.

- Methane Detector Installation – The County contacted the Derwood Station South Home Owners Association (HOA) and individual homeowners to inform them of potential landfill gas migration. Interior spaces of the homes were tested for the presence of methane gas in May/June 2005. The County offered to install methane gas detectors in homes adjacent to the Landfill, of which twelve (12) homeowners accepted.

- MDE Notification – The County via site inspection with MDE on 15 June 2005 and via letter on 14 November 2005 updated MDE on the landfill gas investigation, subsequent monitoring activities, and mitigation efforts along the northwest property boundary of the Landfill.

- Landfill Gas Flare Station Installation – The County received a permit to construct from MDE to build and operate the Flare Station with two (2) enclosed ground flares in June 2004 with operation occurring in May 2005. With the operation of the Flare Station, methane gas concentrations dropped substantially from May to September 2005 along the northwest property boundary.

- Landfill Gas System Operation and Maintenance – SCS Engineers (SCS) performed operation and maintenance of the landfill gas collection system from 2004 to 2009. The County performed daily inspections of the Flare Station from 2005 to 2009.

- Landfill Gas Monitoring Well Installation – County DEP started to monitor the temporary gas monitoring wells (#3-8) in April 2005, which indicated ongoing gas exceedances. In September-October 2005, seven (7) permanent landfill gas monitoring wells (W03-W09) were installed along the northwest property, which are monitored weekly by DEP. The twenty (20) temporary landfill gas monitoring wells were removed in late 2005.

- Landfill Gas System Expansion – Due to continued methane exceedances along the northwest property boundary, thirty-two (32) landfill gas extraction wells were installed in this area with connections to the Flare Station from March 2006 to April 2008.

- New Landfill Gas-to-Energy Facility Installation – From December 2007 to July 2009, the County in conjunction with the Northeast Maryland Waste Disposal Authority and SCS (after a competitive bid process), worked together to design, construct, and operate a new landfill gas-to-energy (LFGE) facility at the Landfill. The MDE permit to construct was issued in September 2008 and construction began in December 2008. Power export to the grid occurred in June 2009.

- Dioxin/Furan Air Emissions Testing – At the request of the Gude Landfill Concerned Citizens (GLCC), the County, in conjunction with SCS, conducted testing and evaluate dioxin and furan emissions from the enclosed stack flares and the LFGE facility in November 2009 and March 2010. EA Engineering, Science, and Technology, Inc. (EA) also performed a similar analysis that included health risk-based screening levels. These evaluations concluded that landfill gas control equipment is in compliance with applicable destruction efficiency requirements and associated emission levels will not adversely affect public human health.

- Landfill Gas Monitoring Well Installation – In June 2010, ten (10) additional gas monitoring wells were installed along the northwest and southwest property boundary (W-01, W-02, W-10, W-11, W-25 through W-30). Future gas monitoring wells are to be located on the northeast and southeast portions of the Landfill.

- ***Water Quality Monitoring* –** In accordance with closure guidance provided by Maryland DHMH, Montgomery County (in 1984) developed and implemented a comprehensive water quality monitoring program at the Landfill, which has been maintained for over twenty-five (25) years. Groundwater monitoring wells were installed in 1984 and in 1988. Groundwater sampling has been conducted semi-annually and has included laboratory analyses for: volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, metals, and water quality indicators. To monitor the quality of groundwater and surface water, the County has been collecting samples at a total of twenty-five (25) monitoring stations: twenty (20) groundwater monitoring wells and five (5) surface water (stream) locations. [Voluntary 1984 – Present].

- ***Stormwater Infrastructure Improvements* –** In 1992-1993, Montgomery County (in conjunction with SCS) developed engineered plans and specifications for a series of stormwater infrastructure improvements at the Landfill. The site improvements were implemented in 1993-1994 to collect and direct stormwater off of the Landfill site. The site improvement work included, but was not limited to, the construction of stormwater diversion berms; drainage swales channels with conveyance piping; stormwater collection manholes; sediment basin upgrades to accommodate increased stormwater volume; and access road construction. Following project completion, the volume of landfill gas condensate being collected and managed at the CPPI Landfill Gas-to-Energy Facility was significantly reduced. Refer to **Appendix A** (Attachment 3, Stormwater Infrastructure Review) for more detailed information [Voluntary 1992 – 1994].

## 1.5 COMMUNITY CONSULTATION

In November 2008, the Montgomery County Department of Public Works and Transportation (DPWT) contracted with SCS to prepare a preliminary Feasibility Study to relocate County Facilities to the Landfill. Within the Feasibility Study Report, SCS evaluated the potential relocation of a County Bus Depot that would include a parking lot for approximately three hundred fifty (350) school buses, a fueling station, a maintenance building, and other associated support facilities on approximately thirty-two (32) acres of the Landfill property.

The neighboring residential community, Derwood Station, objected to this potential land redevelopment and subsequently formed the GLCC to represent community interests. GLCC is a community-based advisory group with respect to existing conditions, operational activities, and land reuse at the Landfill. The HOA presidents from each of the three (3) Derwood Station communities (Derwood Station 1, Derwood Station 2, and Derwood Station South) are represented within GLCC. GLCC shares information regarding the Landfill with the HOAs via newsletters. Per direction from the County Executive, the Bus Depot project at the Landfill was later withdrawn by County DPWT. GLCC also opposed the Yard Trim Processing Facility project that was proposed by DEP for the Landfill.

During calendar year 2008, County DEP water quality monitoring data was requested by GLCC. GLCC reviewed the data and contended that the reported analyte (contaminant) concentrations in the groundwater and surface water samples exceeded the MCLs established by EPA as limits for drinking water. Through GLCC communication with MDE, MDE requested water quality monitoring data, which was provided by DEP in December 2009.

From June 2009 to present, representatives of County DEP, GLCC, and the County's contracted consultant for technical support (EA) have held monthly meetings at the Shady Grove Transfer Station located at 16101 Frederick Road in Derwood, Maryland. Discussion topics include ongoing operational and post-closure care maintenance activities at the Landfill, and progress, findings, analyses, reports, and potential remedial alternatives related to the Nature and Extent Study. Land reuse is also a recurring topic at the monthly meetings. Meetings are typically held the second Thursday of each month at 7:30-9:00 p.m. and are open to the public.

The County has created a website forum to present meeting minutes, analyses, reports, and other information regarding the Landfill and associated remediation efforts. Refer to **Appendix A** (Attachment 4, County Contact and Website Documentation).

## 1.6 REGULATORY CONSULTATION

Since the Landfill closed in 1984 until the present, the County has openly communicated with MDE concerning existing conditions at the Landfill and other site issues that may potentially impact public health and safety (e.g., landfill gas migration). Correspondence has been in the form of site inspections, meetings, letters, emails, and phone communication. Below is a summary of correspondence of the County and MDE during the years 2008-2010.

- ***Site Inspections* –** MDE has conducted inspections in conjunction with County representatives to review: existing site conditions, post-closure activities, compliance and mitigation measures, and other operational activities at the Landfill. MDE site inspections occurred on the dates listed below with most inspections being documented via MDE Reports of Observations:

  - 2008 – 13 and 17 November.

  - 2009 – 23 January, 12 and 25 February, 27 March, 15 April, 4 May, and 8 and 28 July.

  - 2010 – 10 January and 16 August.

- ***Meetings*** – MDE has conducted meetings in conjunction with the County to discuss: existing site conditions, post-closure care activities, alternative site redevelopment and reuse, compliance and mitigation measures, and other operational activities at the Landfill. Below is a summary of recent meetings between MDE and the County:

  - 30 October 2008 – Representatives from MDE and County DEP held a meeting to discuss the requirements of the proposed Bus Depot project. MDE stated that design plans including landfill gas collection measures would need to be submitted for review and approval. Regarding existing conditions at the Landfill, DEP noted that there are exceedances of MCLs in groundwater and exceedances of MDE Groundwater Cleanup Standards for metals in surface water, as measured around the Landfill through DEP's water quality monitoring program, which has been in place for nearly twenty-five (25) years. DEP also noted that there are occasional exceedances of the LEL for methane along the northwest portion of the Landfill property boundary. This property boundary borders the Transco/Columbia Gas natural gas right-of-way and the Derwood Station Community. A dozen homes located adjacent to the northwest property boundary of the Landfill have methane detectors, and gas monitoring is conducted along this property boundary on a weekly basis by DEP.

    Following the meeting and in conjunction with public information requests from GLCC, MDE requested water quality monitoring data from the Landfill. County DEP provided water quality monitoring data (from April 2001 to March 2008) to MDE in December 2008. Following review of the water quality data from the Landfill, MDE acknowledged GLCC's site concerns, noted regulatory compliance standards and required the County to initiate a study to assess potential adverse environmental or health and safety impacts of the Landfill. MDE stated that all proposed land uses (including the Bus Depot and Yard Trim projects) at the Landfill are to be postponed until the study is completed.

- 26 February 2009 – Representatives from MDE and County DEP held a meeting to discuss the preparation of and requirements for planning documents for the Landfill: groundwater and surface water monitoring plan, landfill gas monitoring plan, and the remediation plan. MDE stated that groundwater monitoring results shall be in accordance with EPA drinking water standards at the property line (MCL limits), surface water shall meet surface water requirements, and a groundwater flow map will be required. MDE stated that landfill gas monitoring wells will need to be installed along all portions of the perimeter property boundary that do not have a hydrologic barrier. MDE stated the remediation plan will require a Nature and Extent Study to assess existing conditions and the extent of contamination from the Landfill site and an associated project schedule. MDE's remediation goals include:

  - No MCL exceedances in the groundwater at the Landfill property boundary or between the Landfill and adjacent streams.

  - No non-stormwater discharges to the waters of the State.

  - No LEL exceedances for methane at the Landfill property boundary.

  MDE also stated that the proposed Yard Trim Processing Facility cannot move forward until the Nature and Extent Study is completed and MDE approves a remedial action plan. A comprehensive post-closure care plan will be required following remediation activities.

- 21 December 2009 – Representatives from MDE and County DEP held a meeting to discuss the remediation approach, landfill gas monitoring, and cover system conditions on the northwest slope of the Landfill. The County reviewed the results of the Limit of Waste Delineation Study that concluded waste was placed several hundred feet onto M-NCPPC land, which is northeast of the Landfill. MDE stated the County should obtain control or long-term access for maintenance of the entire Gude Landfill waste disposal footprint. MDE directed the County to proceed with the installation of landfill gas monitoring wells along the perimeter property boundary, where there is no waste beyond the property boundary. MDE directed the County to prepare a formal action plan to address leachate seeps on the northwest slope and in any other location on the Landfill property.

- ***Letters* –** MDE has issued formal letters to issue compliance directives regarding post-closure care maintenance and monitoring activities at the Landfill. Due to the existing conditions at the closed Landfill, MDE mandated the County to take the following actions as documented in the referenced correspondence (see also **Appendix A,** Attachment 5, Regulatory Correspondence):

  - MDE to County Letter dated 12 December 2008 – formalize current monitoring program for landfill gas and investigate the placement of additional landfill gas monitoring wells. Prepare and submit a monitoring plan for MDE approval. MDE approved the County Landfill Gas Monitoring Plan on 22 April 2009. Landfill gas monitoring and reporting to MDE occur on a quarterly basis.

  - MDE to County Letter dated 28 January 2009 – formalize current monitoring program for water quality (groundwater and surface water). Prepare and submit a monitoring plan for MDE approval. MDE approved the County Groundwater and Surface Water Monitoring Plan on 11 May 2009. Groundwater and surface water monitoring and reporting to MDE occur on a semi-annual basis.

  - MDE to County Letter dated 28 January 2009 – prepare a remediation plan to assess the nature and extent of low level groundwater contamination in the vicinity of the Landfill as well as develop mitigation measures for gas migration, leachate seeps, stormwater ponding, waste encroachment on adjacent properties, and other site compliance issues. Prepare and submit a Nature and Extent Study and/or supplemental documentation for MDE review and evaluation. MDE approved the County Remediation Approach on 27 May 2009.

## 1.7 TECHNICAL SUPPORT FOR NATURE AND EXTENT STUDY

Through the Northeast Maryland Waste Disposal Authority (NMWDA), County DEP obtained environmental and engineering services from EA. EA was contracted to provide technical support with the assessment and remedial investigations required in the Nature and Extent Study. The scope of work included, but was not limited to, the following: an aerial site survey; field survey of existing site infrastructure; metes and bounds survey of the property boundary, limits of waste delineation; permitting and installation of new groundwater monitoring wells; and groundwater and surface water sampling and analyses of new and existing monitoring wells to assess the nature and extent of potential environmental impacts from the Landfill.

## 1.8 OBJECTIVES AND COMPONENTS OF THE NATURE AND EXTENT STUDY

As part of the Nature and Extent Study, EA reviewed historical data and conducted field investigations, as described below:

- Limit of Waste Delineation
  As part of Phase 0, a waste delineation study was conducted to locate the approximate horizontal extent of waste around the perimeter of the Landfill. A report was prepared (EA 2010a), and the findings are summarized in a technical memorandum in **Appendix A** (Attachment 6, Waste Delineation Technical Memorandum).

- Aerial and Field Survey
  Various U.S. Geologic Survey (USGS) topographic maps were reviewed along with several aerial photographs to obtain surface water background information. A field survey of groundwater monitoring wells and a surface water survey was completed. Stormwater structures at the Landfill were also evaluated. These activities are summarized in a technical memorandum in **Appendix A** (Attachment 7, Aerial and Field Survey Technical Memorandum).

- Protected Resources
  A wetland delineation and forest stand delineation was performed as part of a preliminary site assessment for the Landfill to evaluate the presence and extent of wetlands/waterways, and number and type of forest stands. These efforts are summarized in a technical memorandum in **Appendix A** (Attachment 8, Protected Resource Investigations Technical Memorandum).

- Historical Landfill Data Review
  Groundwater monitoring well construction logs and historical monitoring data were reviewed. Historic sampling data were reviewed for existing wells and surface water sampling locations. Historical landfill gas monitoring data were also evaluated. The findings of this review were presented in the Nature and Extent Study Plan (EA 2010b).

- Groundwater Sampling and Monitoring Well Installation
  Sixteen (16) new monitoring wells were installed to evaluate groundwater concentrations at several intervals of potential impact. Groundwater samples from the sixteen (16) new monitoring wells and twenty (20) existing wells were collected and analyzed for VOCs,

SVOCs, metals, herbicides, pesticides, polychlorinated biphenyls (PCBs), cyanide, and sulfide. Results are presented and discussed in this Report.

- Surface Water Sampling
  Samples were collected from five (5) existing and five (5) new surface water locations at offsite streams around the perimeter of the Landfill to monitor water quality. The samples were analyzed for VOCs, SVOCs, metals, herbicides, pesticides, PCBs, cyanide, and sulfide. Results are presented and discussed in this Report.

- Subsurface and Surface Soil Sampling
  Surface soil grab samples were collected from eleven (11) locations and subsurface soil samples were collected from the sixteen (16) monitoring well locations during well installation via split spoon. Soil samples were analyzed for VOCs, SVOCs, metals, herbicides, pesticides, PCBs, cyanide, and sulfide. Results are presented and discussed in this Report.

This Nature and Extent Study Report presents a site description, historical data and field review summary, an overview of existing environmental regulations, a summary of the nature and extent investigation, a human health and ecological risk evaluation, and findings and conclusions from the Nature and Extent Study.

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# 2. SITE DESCRIPTION

## 2.1 SITE LOCATION AND CHARACTERISTICS

The Landfill is located at 600 East Gude Drive in Rockville, Maryland (**Figure 2-1**). The surrounding area and property border of the Landfill is primarily mixed use: industrial operations (east by southeast); Washington Suburban Sanitary Commission (WSSC) property and E. Gude Drive (south); a Transcontinental/Columbia Gas natural gas pipeline and the community of Derwood Station South (west); and M-NCPPC land (north by northeast). The Landfill is also bordered by surface water bodies: Crabbs Branch Stream (north by northeast) and Southlawn Branch Stream (south by southeast).

The Landfill property is approximately one hundred sixty-two (162) acres in size with an estimated waste disposal footprint of one hundred (100) acres. There is approximately sixteen and a half (16.5) acres of waste encroachment on M-NCPPC property. The depth of waste varies across the site from approximately fifty-five (55) to ninety (90) ft. Total waste in place is estimated at four and eight-tenths (4.8) million tons.

The site topography is plateau-like and consists of gentle relief (i.e., slope) along the top of the waste-mass and sharp relief along the Landfill boundary. The elevation along the top of the plateau gently slopes to the south, with localized mounds and depressions throughout. The side slope falls sharply from the top of the waste-mass to elevations ranging from fifty-five (55) to ninety (90) ft below the plateau. The Landfill surface generally consists of open grassy fields with sporadic patches of trees.

Major site features of the Landfill property include: an extensive aboveground landfill gas collection system with approximately eighty-five (85) gas extraction wells, a Flare Station and a Gas-to-Energy Facility; stormwater conveyance piping and stormwater collection ponds; a five-tenths (0.5)-acre concrete pad used for stormwater debris and leaf management; a model airplane flying area and pavilions; a men’s shelter with administrative offices (not built on waste); onsite and offsite groundwater monitoring wells; landfill gas monitoring wells; and access roads to site infrastructure.

## 2.2 SITE GEOLOGY AND HYDROGEOLOGY

The Landfill is located in central Montgomery County, Maryland, within the upland section of the Piedmont Plateau physiographic province (Maryland Geologic Society 1968, Trapp and Horn

1997).  The geology in the upland section of the Piedmont Plateau physiographic province primarily consists of metamorphic and igneous rock formations of Paleozoic and Precambrian age.  The Piedmont Plateau is underlain by an assortment of phyllite, slate, marble, schist, gneiss, and gabbro formations.  Unconsolidated sediments overlying bedrock are present at the surface in the vicinity of the site and extend twenty (20) to sixty (60) ft below ground surface (bgs). Based on available groundwater monitoring well construction logs from ATEC Associates Inc. (1988), the sediments primarily consist of silt and clay.

The uplands section of the Piedmont is underlain by three (3) principle types of bedrock aquifers: crystalline-rock and undifferentiated sedimentary-rock aquifers, aquifers in early Mesozoic basins, and carbonate-rock aquifers (Trapp and Horn 1997).  The Landfill is underlain by the crystalline rock aquifer that extends over approximately eighty-six (86) percent of the Piedmont Plateau Physiographic Province.  At the Landfill, the crystalline rock that composes the regional aquifer is overlain by unconsolidated material consisting of interbedded silts and clays and saprolite.  Groundwater is present in the unconsolidated material as well as the bedrock. Groundwater flow is highly dependent on the composition and grain size of the sediments, and therefore water likely moves more readily in the unconsolidated material than in the underlying bedrock.  Groundwater in the bedrock (typically twenty [20] to sixty [60] ft below grade) is stored in, and moves through, fractures.  No documentation of the degree of fracturing or orientation of bedrock fractures at the Landfill was found, nor did EA assess the Landfill in this respect.

The groundwater table is typically present in the unconsolidated sediments along the perimeter of the Landfill and under the Derwood Station development, at depths ranging from approximately three (3) to sixty (60) ft bgs.  Groundwater recharge at the Landfill is variable and is primarily determined by precipitation and runoff.  Topographic relief, unconsolidated sediment, and surface recharge variations created by the former landfill may significantly affect the groundwater flow.  The site topography and the natural cover system (grassy surface soil layer) of the Landfill make surface water infiltration likely.  Some of the infiltrating water likely moves vertically into the bedrock, while a portion also moves laterally along the boundary between the unconsolidated layer and the surface of the bedrock and discharges to nearby streams and surface depressions.

Geologic cross-sections of the Landfill area, showing the subsurface geology and the relative depths of unconsolidated sediments, bedrock, and groundwater, are presented in **Figures 2-2 and 2-3**.

# 3. HISTORICAL DATA AND FIELD REVIEW

## 3.1 HISTORICAL WATER QUALITY MONITORING PROGRAM

In accordance with closure guidance provided by Maryland DHMH, Montgomery County (in 1984) developed and implemented a comprehensive water quality monitoring program at the Landfill, which has been maintained for over twenty-five (25) years. Groundwater monitoring wells were installed in 1984 and in 1988. Groundwater sampling has been conducted semi-annually and has included laboratory analyses for VOCs, SVOCs, pesticides, metals, and water quality indicators. To monitor the quality of groundwater and surface water, the County has been collecting samples at a total of twenty-five (25) monitoring stations: twenty (20) groundwater monitoring wells and five (5) surface water (stream) locations.

The twenty (20) groundwater monitoring wells are located on the Landfill property (County owned) and adjacent Park Land (M-NCPPC owned). The surface water locations are found in streams located adjacent to and downstream of the Landfill: Crabbs Branch Stream, Southlawn Branch Stream, and Middle Rock Creek Stream. As discussed previously, the County DEP developed and implemented a groundwater and surface water monitoring program for the Landfill. The analytical data are also monitored and maintained by County DEP. Historical data analyses indicate low-level groundwater impacts along the Landfill property boundary.

MCL exceedances have been reported in the groundwater and surface waters. Groundwater and surface water monitoring requirements as well as public drinking water standards are established by MDE in COMAR 26.04.07.08B(17) and 26.04.07.09F and EPA (National Primary Drinking Water Standards per the Safe Drinking Water Act – SDWA). These requirements and standards are attributed to water quality monitoring and reporting programs for municipal solid waste landfills.

Local groundwater aquifers near the Landfill are not the source for potable water for neighboring residential dwellings and commercial businesses. Public water service is supplied through the WSSC. There are no active private water supply wells adjacent to or in immediate proximity to the Landfill.

### 3.1.1 Groundwater

A total of thirty-six (36) monitoring wells are currently located at the Landfill (**Figure 3-1**). Twenty (20) of those wells were previously installed at the Landfill, and sixteen (16) were installed during this Nature and Extent Study. Sixteen (16) of the previously installed groundwater monitoring wells were constructed of two (2)-inch (in.)-diameter PVC, and four (4) were constructed of four (4)-in.-diameter PVC. For the previously installed monitoring wells, well construction logs are available for twelve (12) of the two (2)-in.-diameter wells, but unavailable for the other four (4) (OB06, OB10, OB11A, and OB12) and for all four (4), four (4)-in.-diameter wells (OB15, OB25, OB102, and OB105). A summary of the well construction data from the available construction logs, with field data collected for the wells more recently, is presented in **Table 3-1**.

The two (2)-in.-diameter monitoring wells (based on those with construction logs available) were typically screened below the interface between unconsolidated sediments and bedrock, and significantly below the surface of the groundwater (at zero [0] to twenty-five [25] ft bgs). Screened intervals range from twenty-six (26) to seventy-six (76) ft bgs in OB07A to one hundred four (104) to one hundred fifty-four (154) ft bgs in OB03, and are twenty (20) to ninety (90) ft below the water table. Six (6) monitoring well pairs with screened intervals at different depths were constructed. For example, OB03 was installed with a screened interval from one hundred four (104) to one hundred fifty-four (154) ft below grade, and adjacent well OB03A was installed with a screened interval from fifty (50) to ninety-seven (97) ft bgs. The monitoring well pairs are OB02/OB02A, OB03/OB03A, OB04/OB04A, OB07/OB07A, OB08/OB08A, and OB11/OB11A. Monitoring well construction logs (available for these well pairs, except OB11A, and for OB01) indicate that the wells were installed from April through October 1988 by ATEC Associates, Inc. The monitoring wells constructed of four (4)-in.-diameter PVC or steel casing (OB15, OB25, OB102, and OB105) were constructed to depths ranging from thirteen (13) to twenty-eight (28) ft bgs. The date of installation and monitoring well construction details, including the depth of the screened intervals for these wells is not known due to the absence of well construction logs.

Reported historical groundwater sampling data for the twenty (20) existing monitoring wells at the Landfill have included concentrations exceeding the MCLs established by EPA. Historical groundwater sampling data are discussed in Section 3.2.2.

The depth of the existing wells, below the water table, represented a limitation to effective groundwater monitoring at the site. Water quality data from wells that intersect the surface of the groundwater can reveal potential non-aqueous contaminants that may be migrating along the groundwater surface (e.g., petroleum or other liquids lighter than water). Additionally, characterization of the saturated interface where the unconsolidated sediments are in contact with consolidated bedrock is important, as potential contaminants may be migrating along this interface prior to entering the bedrock fracture system.

Sixteen (16) new groundwater monitoring wells were therefore installed during June and July 2010 (see **Table 3-2** for construction data). Well depths were selected to evaluate potential contaminant of concern (COC) concentrations in groundwater at several intervals of potential impact starting at the perimeter of the Landfill and working out (away from the perimeter). For example, shallow/deep groundwater monitoring well pairs were proposed in areas where there were no existing data, and shallow wells were proposed in areas where shallow groundwater data were not available from existing monitoring wells. Screened intervals in the shallow monitoring wells were twenty (20) to thirty (30) ft long and properly intersected the groundwater surface. Screened intervals in the deep wells were twenty (20) ft long and were positioned at the bottom of the borings. Monitoring well installation is discussed in detail in Section 5.2.

After the installation and development of the monitoring wells, groundwater sampling was conducted at the twenty (20) existing and sixteen (16) new monitoring wells. Samples were analyzed for:

- VOCs by EPA Method 8260;
- SVOCs by EPA Method 8270;
- Metals by EPA Method 6020;
- Herbicides by EPA Method 8151;
- Chlorinated pesticides by EPA Method 8081;
- Organophosphate pesticides by EPA Method 8141;
- PCBs by EPA Method 8082;
- Cyanide by EPA Method 9010; and
- Sulfide by EPA Method 9030.

Groundwater sampling is discussed in detail in Section 5.3.

### 3.1.2 Surface Water

Surface water bodies in the vicinity of the Landfill include Crabbs Branch along the northeastern property boundary and Rock Creek east of the Landfill. Southlawn Branch and other un-named tributaries of Rock Creek are located south of Crabbs Branch and along the southern property boundary. Surface water has been historically sampled at the Landfill at sampling locations ST065, ST015, ST120, ST70, and ST80 (**Figure 3-2**). Of these sampling locations, ST70 is the only one located onsite. Surface water samples were collected semi-annually and analyzed for herbicides, pesticides, metals, SVOCs, and VOCs. Historical surface water sampling data were compared to MDE Groundwater Cleanup Standards (MDE 2008). The reported concentrations of some constituents exceeded the MCLs. Historical surface water sampling results are discussed in Section 3.3.2.

Five (5) additional surface water sampling locations were added for the evaluation of potential surface water impacts from the Landfill (**Figure 3-2**). These are located immediately downstream of the stormwater outfalls adjacent to OB08/OB08A (SW-4) and OB11/OB11A (SW-5), upstream of current sampling location ST065 (SW-3), and in two (2) separate ponds at the northern corner of the Landfill property (SW-1 and SW-2). Surface water sampling is discussed in detail in Section 5.4.

## 3.2 GROUNDWATER MONITORING DATA REVIEW

### 3.2.1 Groundwater Flow Direction

The depth to groundwater was measured in the twenty (20) existing groundwater monitoring wells by EA personnel on 5 November 2009. Measurements were collected by lowering an electronic water level indicator to determine the depth to water at each well. Depth-to-water measurements were collected from surveyed locations marked along the well casings. Groundwater elevation data collected from the existing monitoring wells indicated an easterly flow direction across the Landfill, with minor northeasterly and southeasterly components, and a hydraulic gradient of approximately two one-hundredths (0.02) to three one-hundredths (0.03). Shallow and deep wells in well pairs had very similar water levels, indicating that no vertical gradient is present.

It is likely that some degree of groundwater mounding is present beneath the Landfill. This mounding cannot be fully defined by the monitoring wells, which are located primarily along the landfill perimeter. Furthermore, the proximity of the existing monitoring wells to the waste may have an influence on groundwater elevations within the wells. For example, local groundwater mounding beneath the landfill (for which there are no piezometers or groundwater monitoring wells) may result in radial flow away from the landfill to the immediate perimeter monitoring wells. The installation of additional monitoring wells as part of the Phase 1 effort provided improved resolution of groundwater elevations and flow directions (see Section 5.3).

### 3.2.2 Dissolved Phase Constituents (2001 – 2009)

For each existing groundwater monitoring well, concentration-time graphs were plotted for each constituent with at least one (1) reported MCL exceedance in that well, to evaluate potential trends (**Appendix B**). The reported concentrations of seven (7) VOCs consistently exceeded MCLs in multiple wells, and were identified as COCs for the Landfill: 1,2-dichloropropane, benzene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride. Occasional exceedances of metals and other VOCs were also reported historically, but these exceedances were not consistent or widespread; therefore, these are not considered COCs. Overall, of the more than sixty-one thousand (61,000) constituents analyzed from all groundwater samples collected historically (April 2001 to September 2010) from the twenty (20) existing groundwater monitoring wells at the Landfill, six hundred forty-eight (648) exceedances of MCLs have been reported.

The following summarizes the concentrations of COCs detected in historical groundwater samples. A summary of reported historical COC concentrations can be found in **Table 3-3.**

- Wells OB01, OB02, OB02A

Groundwater monitoring wells OB01, OB02 (deeper), and OB02A (shallower) are located in the southwestern corner of the site, and screened at least twenty (20) ft below the water table. MCL exceedances for four (4) COCs – TCE, cis-1,2-dichloroethene, PCE, and vinyl chloride – were reported in these monitoring wells between 2001 and 2009. The only MCL exceedance reported since 2005 is for vinyl chloride in well OB01. In general, these wells show a trend of decreasing VOC concentrations.

- Wells OB03 and OB03A

Groundwater monitoring wells OB03 (deeper) and OB03A (shallower) are located along the northwest boundary of the site, and screened at least twenty-five (25) ft below the water table. MCL exceedances for six (6) COCs—benzene, 1,2-dichloropropane, cis-1,2-dichloroethene, TCE, PCE, and vinyl chloride—were detected in these monitoring wells between 2001 and 2009.

Concentrations of 1,2-dichloropropane, cis-1,2-dichloroethene, TCE, and vinyl chloride have consistently exceeded MCLs. PCE concentrations appear to have a seasonal signal, with MCL exceedances in autumn but not in spring, and benzene concentrations have also varied around the MCL. In general, these monitoring wells show a trend of either inconsistent or increasing VOC concentrations, although the range of concentrations is within an order of magnitude.

- Wells OB04, OB04A, 0B06, OB07, OB07A, OB102, and OB105

Groundwater monitoring wells OB04 (deeper), OB04A (shallower), 0B06, OB07 (deeper), OB07A (shallower), OB102, and OB105 are located beyond the northeastern boundary of the site, and those for which records are available are screened at least twenty (20) ft below the water table. These wells are generally not highly impacted. However, occasional MCL exceedances for vinyl chloride have been reported in three (3) of the seven (7) wells between 2001 and 2009, and one (1) MCL exceedance for methylene chloride was reported in OB04A in 2001.

- Wells OB08, OB08A, and OB10

Groundwater monitoring wells OB08 (shallower), OB08A (deeper), and OB10 are located in the southeastern portion of the site, downgradient from the Landfill, and screened below the water table. MCL exceedances for all seven (7) COCs were detected in at least one (1) of these wells between 2001 and 2009. However, PCE has been below MCLs in all three (3) wells since 2005, and 1,2-dichloropropane, benzene, cis-1,2-dichloroethene, and methylene chloride each had only one (1) exceedance, in 2002 in well OB08A. Recent exceedances of TCE (since 2005) have occurred only in OB10, where the TCE concentration has generally decreased since 2001. Since 2009, all three (3) wells have shown MCL exceedances of vinyl chloride, which appears to be consistent or increasing in concentration.

- Wells OB11, OB11A, OB12, OB015, and OB025

Groundwater monitoring wells OB11 (deeper), OB11A (shallower), OB12, OB015, and OB025 are located along the southern boundary of the site. MCL exceedances for all seven (7) COCs were historically detected in these monitoring wells during various sampling events between 2001 and 2009, with most exceedances occurring in wells OB11, OB11A, and OB12. 1,2-Dichloropropane, PCE, TCE, and vinyl chloride show consistent or increasing concentrations, often above MCLs, in OB11, OB11A, and OB12. Similar trends are seen for benzene and cis-1,2-dichloroethene, but with MCL exceedances only in OB11 and OB11A. All three (3) of these monitoring wells have had MCL exceedances for methylene chloride since 2007, but the concentration trends in these wells are inconsistent (increasing in OB11, decreasing in OB11A, and consistent in OB12). Wells OB025 and OB015 also show exceedances for vinyl chloride, with a seasonably variable or slightly decreasing trend in concentrations. In general, these wells show a trend of increasing VOC concentrations, with concentrations remaining within the same order of magnitude.

- Summary

COC concentrations are generally consistent or increasing along the north-northwestern and south-central boundaries of the Landfill. Monitoring wells OB11 and OB11A in the south and OB03 and OB03A in the north are the most highly impacted monitoring wells overall. Exceedances of PCE, TCE, cis-1,2-dichloroethene, and vinyl chloride have been reported in all four (4) of these wells. These constituents, in the order written, represent the series of products of dechlorination, a biological process that often occurs in aquifers impacted by chlorinated solvents. The occurrence of these constituents therefore could be evidence of natural attenuation in the groundwater beneath and surrounding the Landfill.

Meanwhile, concentrations have decreased historically along the southeast boundary of the site (with the exception of vinyl chloride, which has increased), and in the southwest corner of the site. These areas have historically shown exceedances of PCE, TCE, cis-1,2-dichloroethene, and vinyl chloride, but all except vinyl chloride (in the southeast) have been reported at concentrations less than the MCLs in recent years. The northeastern portion of the site is the least impacted area, with vinyl chloride as the primary constituent exceeding the MCL.

## 3.3 SURFACE WATER MONITORING DATA REVIEW

### 3.3.1 Surface Water Flow Direction

The USGS Topographic Map for the area (Rockville Quadrangle, see **Figure 2-1**), which was published in 1965 and photorevised in 1984, was used as a reference to identify possible wetland and waterways on the property. Three (3) blue-line stream channels are depicted within the vicinity of the project site on the map. Crabbs Branch is shown along the northern boundary of the project site, flowing east into Rock Creek. Rock Creek is shown east of the project site, farther outside the site boundaries. A third, unnamed stream channel is shown along the southern property line, flowing east into Rock Creek. Crabbs Branch and this unnamed channel were sampled as part of surface water sampling efforts associated with the Landfill.

### 3.3.2 Surface Water Dissolved Phase Constituents (2001 – 2009)

Graphs of historical data (2001-present) for dissolved phase constituents that have exceeded MDE Cleanup Standards for Groundwater are provided in **Appendix B**. The following COCs for surface water were identified based on these historical data: TCE, cyanide, bis(2-ethylhexyl)phthalate, and methylene chloride. However, of the more than thirteen thousand (13,000) constituents analyzed from all surface water samples collected historically (May 2001 to September 2010) in streams near the Landfill, thirteen (13) exceedances of MCLs have been reported. Exceedances in surface water samples between 2001 and 2009 are summarized below.

Surface water sample location ST065 is located in Crabbs Branch, beyond the northwest boundary of the site, cross-gradient-to-upgradient of the Landfill. TCE was detected in March 2009 at a concentration of 7.13 micrograms per liter (µg/L). Exceedances were also reported for bis(2-ethylhexyl)phthalate and total cyanide at single timepoints (September 2002 and September 2006, respectively). Bis(2-ethylhexyl)phthalate is a common laboratory contaminant and this could be the cause of this isolated constituent concentration.

Surface water sample location ST015 is located in the unnamed channel along the southwest boundary of the site, cross-gradient to upgradient of the Landfill. An exceedance of the MDE standard for total cyanide was reported one (1) timepoint (March 2004). No other exceedances of cleanup standards for COCs have been found at this location.

Surface water sample location ST120 is located in Crabbs Branch along the northern site boundary, cross-gradient to upgradient of the Landfill. Bis(2-ethylhexyl)phthalate was reported at a concentration exceeding the MDE cleanup standard at one (1) timepoint (March 2009). No exceedances of MDE cleanup standards among COCs have been found at this location. Again, this exceedance of bis(2-ethylhexyl)phthalate could have resulted from laboratory contamination.

Surface water sample location ST70 is located in the unnamed channel within the southeastern portion of the site, downgradient of the Landfill. Methylene chloride was detected in September 2001 at a concentration of 12.18 µg/L. Bis(2-ethylhexyl)phthalate was also detected above its MDE cleanup standard at two (2) timepoints (October 2007 and March 2008). Laboratory contamination could have contributed to the exceedances of both bis(2-ethylhexyl)phthalate and methylene chloride, as both are common laboratory contaminants.

Surface water sample location ST80 is located in the unnamed channel near where it flows into Rock Creek, east (downgradient) of the Landfill. Methylene chloride was detected above its

MDE Cleanup Standard for Groundwater at one (1) timepoint (September 2009) at a concentration of 5.23 µg/L. This exceedance of methylene chloride could also have resulted from laboratory contamination.

## 3.4 MDE-APPROVED WATER QUALITY MONITORING PROGRAM

Based on water quality data from April 2001 through March 2008, it was indicated that the Landfill may be having an adverse effect on groundwater and surface water. A Groundwater and Surface Water Monitoring Plan (Montgomery County DEP 2009a) was developed in accordance with MDE guidelines and requirements set forth in COMAR 26.04.07.08B (17) and 26.04.07.09F. The Montgomery County DEP will continue to perform groundwater and surface water monitoring until directed otherwise by MDE.

The monitoring program currently consists of semiannual groundwater sampling from twenty (20) wells located on the perimeter of the landfill and semiannual surface water sampling at five (5) locations offsite. Samples are analyzed for VOCs, metals, hardness, nitrates, sulfates, chloride, and ammonia. The sixteen (16) new groundwater monitoring wells are to be added as necessary to the approved Groundwater and Surface Water Monitoring Plan, following MDE review of the Nature and Extent Study.

## 3.5 STORMWATER INFRASTRUCTURE REVIEW

EA prepared a Technical Memorandum (**Appendix A,** Attachment 3) to summarize the findings of the Stormwater Infrastructure Review at the Landfill in an effort to assist the Montgomery County DEP with the assessment and potential remediation of the site. EA reviewed existing drawings of stormwater management structures at the Landfill and created an inventory of existing swales, berms, inlet structures, outlet structure, culverts, detention ponds, and sediment basins. Structures were then inspected during a field review. This review found that most structures appeared to be present and functioning as intended, but that improved maintenance, including vegetation management, would likely improve performance of the stormwater management system. EA also developed a drainage area map showing catchment areas and flow directions for surface runoff.

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# 4. OVERVIEW OF EXISTING ENVIRONMENTAL REGULATIONS

## 4.1 GROUNDWATER

MDE regulations pertaining to groundwater monitoring at solid waste landfill facilities are contained in COMAR Title 26. According to COMAR 26.04.07.22(A), the Landfill is subject to post-closure monitoring and maintenance by MDE for a period of time not less than five (5) years after the complete installation of a landfill cap. Under the post-closure regulations, the status of the monitoring wells must be checked at least two (2) times per year by MDE or an MDE-authorized representative. The Landfill stopped receiving waste prior to 9 October 1991; therefore, it is exempt from 40 CFR Part 258 monitoring requirements (Solid Waste Disposal Facility Criteria).

For groundwater, EPA SDWA MCLs have been established by MDE as the appropriate regulatory guidance for the Landfill. MCLs were developed to regulate potable water quality at potential points of exposure. MCLs include maximum allowable levels of both toxic and carcinogenic compounds in drinking water and are the industry-accepted criteria for assessing environmental impacts. The regulatory applicability of MCLs to this site is established by COMAR 26.08.02, which establishes the MCLs listed in COMAR 26.04.01 as the groundwater quality criteria for Maryland.

As part of the human health risk evaluation, reported concentrations in groundwater were also compared to MDE Cleanup Standards for Groundwater (MDE 2008). The Cleanup Standards were developed to represent concentrations at which no additional remedial action is required, based on the absence of adverse affects to human health resulting from use of the water as a potable water supply. The MDE Cleanup Standards for groundwater are generally the same as MCLs, except for analytes where MCLs have not been established. For analytes where no MCL has been established, the cleanup standard is either (1) a calculated risk-based value using the appropriate residential exposure assumptions for use of groundwater as a potable water source, or (2) the analyte’s practical quantitation limit, if it is higher than the risk-based value. The residential exposure assumptions are based on specific, conservative, fixed levels of risk.

## 4.2 SURFACE WATER

COMAR 26.08.02.07 requires the protection of surface water resources at municipal solid waste landfill (MSWLF) sites. The Montgomery County DEP received a letter on 30 January 2009 (see **Appendix A**, Attachment 5) from MDE requiring, among other things, submission of a

Groundwater and Surface Water Monitoring Plan for the Landfill. MDE's letter directed that the Groundwater and Surface Water Monitoring Plan be prepared in accordance with COMAR 26.04.07.08B(17) and 26.04.07.09F and guidelines set forth in the letter. The Groundwater and Surface Water Monitoring Plan (Montgomery County DEP 2009a) was submitted to MDE by the County DEP on 27 March 2009 and subsequently approved by MDE on 11 May 2009.

For surface water samples collected during the Nature and Extent Study, reported concentrations were compared to the MDE Cleanup Standards for Groundwater (MDE 2008). The MDE Cleanup Standards for Groundwater provide conservative risk screening for surface water because exposure to surface water is significantly less than a potable water supply.

As part of the ecological risk screening, reported concentrations in surface water samples were compared to EPA Region 3 Biological Technical Assistance Group (BTAG) ecological screening values. The BTAG ecological screening values are intended to facilitate consistency in screening-level ecological risk assessments. These values are consistent with MDE water quality standards and are used for the protection of ecological organisms that live in surface water.

## 4.3 SURFACE AND SUBSURFACE SOIL

For surface and subsurface soil collected during the Nature and Extent Study, reported concentrations in soil samples were compared to the MDE Residential and Non-Residential Cleanup Standards for Soil. The Residential Cleanup Standards provide a conservative risk screening for the Landfill soils. The standards are considered conservative because residents of the Derwood Station residential development, northwest of the Landfill, would not achieve residential-level exposure to the Landfill soils, although they may use the site for recreational purposes. The Non-Residential Cleanup Standards are applicable to exposures for potential site workers (e.g., County employees or contractors) who maintain the facility or perform other functions. Specifically, these criteria are calculated based on expected exposure of full-time workers who work at the site year-round.

As part of the ecological risk screening, reported concentrations were also compared to EPA Ecological Soil Screening Levels (EcoSSLs). These values are used for the protection of ecological receptors (birds, mammals, plants, and soil invertebrates) that live in or on soil. EcoSSLs were developed as soil screening values and are not appropriate to be used solely as cleanup levels.

## 4.4 LANDFILL GAS

The Landfill predates 40 CFR 258.23, "Explosive Gases Control." Therefore, gas control at the Landfill is governed by COMAR 26.04.07.03B(9), which establishes methane gas criteria for municipal solid waste landfills. These regulations state that all owners or operators of all municipal solid waste landfill units must ensure that: "*A facility may not be designed or operated in such a manner that the concentration of explosive gases generated by the facility exceeds 25 percent of the lower explosive limits for the gases in facility structures, excluding gas control or recovery system components, and the lower explosive limit for the gases at the property boundary*."

The term "explosive gases" in this regulation refers primarily to methane, which is one of the most common gases found in landfills due to the natural waste decomposition (which typically produces equal parts of methane and carbon dioxide). Methane has an LEL of five (5) percent by volume. Therefore, methane concentrations from landfill gas cannot exceed one and a quarter (1.25) percent methane by volume in onsite structures and cannot exceed five (5) percent by volume at the Landfill property boundary.

In addition to the regulation, the County has developed a Landfill Gas Monitoring Plan (Montgomery County DEP 2009b), as requested by MDE in 2008. The plan outlines and presents procedures related to the monitoring program at the Landfill.

## 4.5 STORMWATER

COMAR 26.08.04.08 describes the general discharge permit program for the state of Maryland. Stormwater at the Landfill is regulated by the state under an NPDES General Discharge Permit for Stormwater Associated with Industrial Activities, General Permit No. 02-SW. The permit requires that a Stormwater SWPPP be prepared and maintained for the facility. As part of the SWPPP, regular inspections and best management practices are performed. The General Permit does not allow for any discharges other than stormwater (i.e., leachate) to surface water.

## 4.6 LEACHATE

As part of Maryland's post-closure monitoring and maintenance for sanitary landfills (COMAR 26.04.07.22), the Landfill is to be inspected twice a year. As part of these inspections, leachate seeps are to be noted and repairs to seeps are to be made within thirty (30) days, unless approved otherwise by MDE.

# 5. NATURE AND EXTENT EVALUATION

## 5.1 INVESTIGATION PLANNING AND LOGISTICS

### 5.1.1 Limit of Waste Delineation

EA performed a review of topographic maps and aerial photographs of the Landfill and conducted a waste delineation study (EA 2010a) to assist the Montgomery County DEP with assessment and remediation planning at the Landfill. These investigations are summarized in a technical memorandum included in **Appendix A** (Attachment 6).

Historical topographic maps indicated that landfill operations began between 1956 and 1965, consistent with reported Landfill history. Aerial photos show clearing and earthwork activities occurring in the northern and eastern portions of the site in the 1963 photo, and throughout the site in the 1970 photo. Excavation and grading activities in the southeastern and southwestern portions of the site, and construction of a stormwater management pond in the southwest, appear in the 1979 aerial photo. The 1970 and 1979 photos both also show Landfill activities extending across the northeastern boundary of the Landfill property.

The waste delineation study, conducted in 2009, found that waste was generally placed within the Landfill property boundary (see figure, **Appendix A**, Attachment 6). The investigation also determined that waste extends two hundred (200) to two hundred fifty (250) ft northeast of the northeastern Landfill property boundary, onto M-NCPPC property.

### 5.1.2 Aerial Mapping and Field Survey

Aerial and field surveys of the Landfill were conducted by Applied Mapping Solutions, Inc. and C.C. Johnson and Malhotra, P.C. These surveys are summarized in a technical memorandum included in **Appendix A** (Attachment 7). The aerial survey used photographs taken 24 June 2009, and identified the location and topography of stormwater infrastructure; the location and elevation of existing groundwater monitoring wells, landfill gas monitoring and extraction wells, landfill conveyance piping, and landfill gas header pipe junctions; and the location and elevation of buildings and fences associated with the flare station and power plant. Following installation of new monitoring wells, as part of this Nature and Extent Study, a field survey was performed to measure the location and elevation of these wells as well as the new landfill gas monitoring wells installed by the County.

### 5.1.3 Protected Resource Investigations

As part of the Nature and Extent Study at the Landfill, EA performed a wetland delineation and forest stand delineation to document and map the existing natural resources in the vicinity of the Landfill. EA completed written inquiries to the U.S. Fish and Wildlife Service (USFWS) and the Maryland Department of Natural Resources (MD-DNR) regarding records of any rare, threatened, or endangered species present within the project boundary. Additionally, EA completed a written inquiry to the Office of Preservation and Compliance at the Maryland Historical Trust (MHT) to determine if there are historical, cultural, and/or archaeological sites or features present at the site.

The complete Forest Stand Delineation and Wetland Delineation Reports were provided to the County as part of the Nature and Extent Study Plan submitted in July 2010 (EA 2010b). A Technical Memorandum providing a detailed summary of the protected resource investigations is included in **Appendix A** (Attachment 8).

## 5.2 GROUNDWATER MONITORING WELL INSTALLATION

### 5.2.1 Permitting

Prior to initiating investigative activities, groundwater monitoring well permits, construction permits, utility clearance, and right-of-entry for offsite locations were obtained. A Maryland licensed well driller obtained well permits for the monitoring wells. The monitoring well permits were submitted to EA prior to mobilization to the site for installation of the wells. Montgomery County DEP applied for a Park Construction Permit with M-NCPPC to install the wells on park property, in the Derwood Station residential development, and along the eastern Landfill property boundary.

### 5.2.2 Offsite Access

Montgomery County DEP coordinated property access and obtained permission for all work performed in the Derwood Station residential development, on M-NCPPC property, and in the Transcontinental/Williams Gas and Columbia Gas right-of-way (along the northwest boundary of the Landfill).

### 5.2.3 Utility Locating

EA contacted Miss Utility and coordinated utility clearance conducted by a private utility locator in areas of excavation.  The utility contractor utilized electro-magnetic or other detection methods to sense the presence of subsurface utilities and mark the horizontal location of utilities on the ground surface.

### 5.2.4 Well Installation Procedures

The installation of groundwater monitoring wells at the Landfill was completed in accordance with the MDE "Specifications for the Design and Construction of Groundwater Monitoring Wells at Solids Waste Disposal Facilities" (MDE 2009).  The depths and locations of the new monitoring wells were chosen to fill data gaps between the existing monitoring wells.  For example, shallow/deep monitoring well pairs were installed in areas where there was no existing data, and shallow wells were installed in areas where deep wells were already present.

The new monitoring wells were constructed of 2-in.-diameter PVC, with 20-ft-long, 2-in.-diameter 20-slot screens.  Screened intervals are positioned at the bottom of the borings, and, in the shallow wells, intersect the groundwater surface.  The annular space of each well was packed with #2 and #00 silica sand and sealed with bentonite and cement at the surface.  The wells were completed with steel protective stickup and concrete pads.  Some offsite monitoring wells (MW-9, MW-10, MW-11A, MW-11B, and MW-12) were completed with a flush-to-grade manhole, as preferred by the offsite property owners.  Well construction data are summarized in **Table 3-2**. Well construction reports and diagrams are located in **Appendix C**.

### 5.2.5 Subsurface Soil Sampling and Results

During drilling activities for the monitoring wells, continuous split-spoon soil samples were collected until sample refusal was encountered, or to a depth of thirty (30) ft bgs (average depth to consolidated rock). Soil samples were inspected for geologic classification, and photoionization detector (PID) readings were recorded to assess organic vapor concentrations. A combustible gas indicator (CGI) was used to monitor the work area for health and safety purposes.  See **Appendix C** for boring logs.

Soil samples were submitted to Phase Laboratories in Baltimore, Maryland for analysis of constituents, including:

- VOCs by EPA Method 8260;
- SVOCs by EPA Method 8270;
- Metals by EPA Method 6020;
- Herbicides by EPA Method 8151;
- Chlorinated pesticides by EPA Method 8081;
- Organophosphate pesticides by EPA Method 8141;
- PCBs by EPA Method 8082;
- Cyanide by EPA Method 9010; and
- Sulfide by EPA Method 9030.

Subsurface soil sample results showed several metals exceeding MDE Residential Cleanup Standards for Soil at all soil boring locations. All boring locations had concentrations of arsenic, chromium, cobalt, and vanadium above the cleanup standard. The concentrations of arsenic, chromium, and vanadium were generally similar to the anticipated typical concentrations (ATCs) in Maryland (MDE 2008), and therefore appear to represent soil background levels. No ATC is available for cobalt. One (1) sample, MW04-SO-2 to 4 (taken at two [2] to four [4] ft bgs in the boring at MW04), had a detectable concentration of PCB Aroclor 1254 (1.7 milligrams per kilogram [mg/kg]), above the MDE Residential Cleanup Standard for Soil of 0.32 mg/kg. See **Table 5-1** for a summary of constituents detected in subsurface soil samples. Complete data tables are included in **Appendix D**, and laboratory analytical reports for subsurface soil samples are included in **Appendix E**.

### 5.2.6 Well Development

The newly constructed groundwater monitoring wells were developed by overpumping (pumping at a high rate to entrain and remove fine sediments) subsequent to their installation. A two (2)-in. stainless steel submersible pump was lowered into the well screen and pumped at a rate that exceeds the recharge capacity of the well. The pump was alternated on and off to allow for backwashing of the borehole with water pumped into the water line between the pump and the land surface. A surge block was also used to agitate and mobilize sediment around the well screen. Pumping and surging was continued until three (3) to five (5) well volumes (minimum) were purged and there was low turbidity in the discharge water (less than ten [10] nephelometric turbidity units and clear to the unaided eye). Turbidity, pH, and temperature were measured and recorded on the Well Development Log for each monitoring well. If water with low turbidity was not present after two (2) hours, pumping was ceased. Water produced during well development was containerized and then properly disposed. Records of well development are included in **Appendix F**.

## 5.3 GROUNDWATER MONITORING AND SAMPLING

### 5.3.1 Groundwater Flow Direction

Groundwater elevation data were collected from the existing and newly installed monitoring wells in July 2010 by lowering an electronic water level indicator to measure the depth to water at each well. The resulting data indicates flow primarily to the north and south from the Landfill, with a hydraulic gradient of approximately 0.015 to 0.03 across most of the site (**Figure 5-1**). Data from the newly installed monitoring wells indicated that primary flow is not to the east, although minor flow components to the east and west are present. These components appear to reflect a radial aspect of groundwater flow around the edges of the Landfill, which is consistent with variability in topography, surface recharge, and potential mounding of water within the waste mass created by the former landfill. The groundwater contours depicted in **Figure 5-1** indicate that wells OB11, OB11A, OB03, and OB03A, where the greatest groundwater impacts were observed, are downgradient from the landfill.

### 5.3.2 Groundwater Monitoring and Sampling

After the installation and development of the groundwater monitoring wells, groundwater gauging and sampling was conducted at the sixteen (16) new and twenty (20) existing groundwater monitoring wells. Prior to sampling, the new monitoring wells were left undisturbed for a minimum period of two (2) weeks to allow for equilibration with subsurface conditions.

Field activities completed during groundwater sampling included: measurement of water levels and water quality parameters, well purging, and collection of groundwater samples from each monitoring well. Well sampling information (including well depth, purge volume, and water quality parameters) was recorded on the groundwater sampling records (**Appendix F**).

Sampling was conducted using the methods described below.

- A physical inspection of each monitoring well was performed and observations were noted on the Groundwater Sampling Log before sampling began.

- The static water level in the monitoring well was determined to the nearest one-hundredth (0.01) ft using a decontaminated water level indicator probe.

- Purging was accomplished by pumping with a stainless steel submersible pump. For each monitoring well, the volume purged was a minimum of three (3) static casing volumes. Purge water was containerized in 55-gallon drums.

- A minimum of fifteen (15) minutes was allowed for the water level in the well to recover before sampling.

- Temperature, pH, and conductivity were measured in the field.

Upon completion of sampling, the submersible pump was removed from the monitoring well and the tubing disposed as municipal waste. The necessary entries on the chain-of-custody form were completed. The labeled and filled sample containers were immediately placed into an iced cooler with bubble wrap or vermiculite to prevent breakage. At the end of the sampling day, the chain-of-custody form was placed in a waterproof plastic bag and taped to the inside lid of the cooler. The purge water, containerized in 55-gallon drums, was transported to the County Oaks Landfill – Leachate Pretreatment Plant.

Samples were submitted for the following laboratory analyses:

- VOCs by EPA Method 8260;
- SVOCs by EPA Method 8270;
- Metals by EPA Method 6020;
- Herbicides by EPA Method 8151;
- Chlorinated pesticides by EPA Method 8081;
- Organophosphate Pesticides by EPA Method 8141;
- PCBs by EPA Method 8082;
- Cyanide by EPA Method 9010; and
- Sulfide by EPA Method 9030.

### 5.3.3 Groundwater Monitoring and Sampling Results

**Figure 5-2** shows the reported groundwater concentrations (in µg/L, which is equivalent to parts per billion, or ppb) of the seven (7) COCs identified in historical data from the July 2010 sampling event, conducted by EA. MCL exceedances were reported for at least one (1) of these COCs at each of the following wells: MW-6, MW-7, MW-9, MW-13A, MW-13B, OB01, OB03, OB03A, OB08, OB08A, OB10, OB11, OB11A, OB12, OB015, and OB025 (**Table 5-2**). **Figure 5-3** shows the spatial distribution of total VOC concentrations across the site, with the highest concentrations occurring north and south of the Landfill. As seen in the historical data, some wells had MCL exceedances for metals: MW9 had an exceedance of the MCL for chromium, and OB11 had exceedances of the MCLs for cadmium and mercury. See **Table 5-2** for a summary of constituents detected in groundwater samples. Complete data tables are included in **Appendix D**, and laboratory analytical reports for groundwater samples are included in **Appendix G**.

### 5.3.4 Constituent Comparison to Historical Data

In addition to the groundwater sampling performed by EA in July 2010 as part of this report, the County collected samples from the monitoring wells in September 2010, in accordance with the approved MDE Groundwater and Surface Water Monitoring Plan for the Landfill (Montgomery County DEP 2009a). The MCL exceedances for the two (2) 2010 sampling events are summarized in **Table 5-3**. Comparison of historical sampling data to data from these sampling events shows fairly consistent spatial distribution of COCs exceeding MCLs.

- Wells OB01, OB02, OB02A, MW-6, MW-7, and MW-9

Existing groundwater monitoring wells OB01, OB02 (deeper), and OB02A (shallower) are located in the southwestern corner of the site and screened at least twenty (20) ft below the water table. Three (3) new shallow monitoring wells intercept the groundwater table in this area: MW-6, near OB-01, and MW-7 and MW-9, to the northwest of the OB02 pair.

Data from these monitoring wells during the 2010 sampling events indicated that the overall trend of decreasing VOC concentrations in this area remains consistent. Between 2001 and 2009, MCL exceedances for four (4) COCs—TCE, PCE, cis-1,2-dichloroethene, and vinyl chloride—were reported in the existing monitoring wells in this area. TCE and cis-1,2-dichloroethene were below detection limits in samples from all six (6) monitoring wells in 2010. MCL exceedances for PCE were found in MW-9, in both July and September 2010. In July

2010, vinyl chloride concentrations exceeded the MCL in wells MW-6, MW-7 and OB01 (where the exceedance represented an increase from recent historical sampling events). Vinyl chloride was below detection limits in all six (6) monitoring wells in September 2010.

- Wells OB03, OB03A, MW-8, MW-10, MW-11A, MW-11B, MW-12 MW-13A, MW-13B

Existing groundwater monitoring wells OB03 (deeper) and OB03A (shallower) are located along the northwest boundary of the site, and screened at least twenty-five (25) ft below the water table. Seven (7) new monitoring wells were also installed to the west and north of this well pair (MW-8, MW-10, MW-11A, MW-11B, and MW-12 to the west, and MW-13A and MW-13B to the north). The locations of these wells were selected to verify historical results observed from samples collected from the OB03 well pair, and to determine whether impacts seen in this well pair are also present in the surrounding area. All except for MW-11B and MW-13B were installed at the groundwater table to intercept shallow groundwater.

MCL exceedances for six (6) COCs (all except methylene chloride) were reported in wells OB03 and OB03A between 2001 and 2009. For the OB03 and MW-13 well pairs, exceedances were reported for all six (6) of these COCs during at least one (1) of the 2010 sampling events (July or September), consistent with historical data from OB03 and OB03A. In addition, exceedances were reported for methylene chloride in MW-13A and MW-13B. Data from the 2010 sampling events thus indicate that VOC concentrations continued to exceed MCLs in the original OB03 well pair, and that the MCL exceedances extend to the north but not to the west. No exceedances for the COCs were reported in the five (5) wells to the west of OB03.

- Wells OB04, OB04A, 0B06, OB07, OB07A, OB102, OB105, MW-1, MW-2A, and MW-2B

Groundwater monitoring wells OB04 (deeper), OB04A (shallower), 0B06, OB07 (deeper), OB07A (shallower), OB102, and OB105 are located beyond the northeastern boundary of the site, and those for which records are available are screened at least twenty (20) ft below the water table. New well MW-2A was installed at the groundwater table in this area, and MW-1 and MW-2B were installed deeper in the aquifer. As was the case for most historical sampling events, the only COC exceedances reported in these monitoring wells during the 2010 sampling events were for vinyl chloride (in OB04, OB04A, and OB105 during the July sampling event). No exceedances were reported in the new monitoring wells.

- Wells OB08, OB08A, OB10, MW-3A, MW-3B, and MW-4

Groundwater monitoring wells OB08 (shallower), OB08A (deeper), and OB10 are located in the southeastern portion of the site, downgradient from the Landfill, and screened below the water table. New monitoring wells MW-3A and MW-4 were installed at the groundwater table in this area, and MW-3B was installed deeper in the aquifer. MCL exceedances for all seven (7) COCs were reported in these monitoring wells between 2001 and 2009. In general, these wells have shown a trend of decreasing VOC concentrations. The only MCL exceedances reported in this area during the 2010 sampling events were consistent with recent historical exceedances: TCE in OB10 and vinyl chloride in OB08, OB08A, and OB10. No MCL exceedances were reported in the new wells in this area.

- Wells OB11, OB11A, OB12, OB015, and OB025

Groundwater monitoring wells OB11 (deeper), OB11A (shallower), OB12, OB015, and OB025 are located along the southern boundary of the site. No new monitoring wells were installed in this area. MCL exceedances for all seven (7) COCs were historically reported in these monitoring wells during various sampling events, with most exceedances occurring in OB11, OB11A, and OB12. During the 2010 sampling events, concentrations of 1,2-dichloropropane, PCE, and TCE continued to exceed MCLs in OB11, OB11A, and OB12, and vinyl chloride continued to exceed MCLs in all five (5) wells. Methylene chloride concentrations continued to exceed MCLs in OB11 and OB12, and remained near the MCL in OB11A. Benzene and cis-1,2-dichloroethene concentrations generally continued to exceed MCLs in OB11 and OB11A. The highest concentration of cis-1,2-dichloroethene reported to date in this monitoring well group was from OB11 in July 2010. In general, these wells exhibit trends of increasing VOC concentrations.

- Summary

The 2010 groundwater sampling data indicate that the north-northwestern and south-central boundaries of the Landfill continue to have the greatest impacts by COCs, whereas most COCs, except vinyl chloride, generally remain below MCLs in the southwest, southeast, and northeast portions of the site. Data from the newly installed monitoring wells indicates that the impacts reported in the OB03 well pair extend north, but not west toward the Derwood Station residential development.

## 5.4 SURFACE WATER SAMPLING

### 5.4.1 Surface Water Sampling

Ten (10) surface water samples, from five (5) existing surface water sampling locations and five (5) new surface water sampling locations, were collected in August 2010 from offsite streams around the perimeter of the Landfill to monitor the water quality (**Figure 3-2**).

The surface water samples were collected from the designated stream sampling locations and placed directly into the sample bottles provided by the analytical laboratory. For samples that required pre-preserved sample bottles, surface water samples were collected in a decontaminated, long-handled or measuring cup-type polytetrafluoroethylene or stainless steel sampler, or a sampling container. Samples were then transferred into the appropriate bottle ware. Sampling was performed deliberately and methodically to minimize disturbance of bottom sediments, yet as quickly as possible to ensure a representative sample.

The surface water samples were analyzed for:

- VOCs by EPA method 8260;
- SVOCs by EPA method 8270;
- Metals by EPA method 6020;
- Herbicides by EPA method 8151;
- Chlorinated pesticides by EPA method 8081;
- Organophosphate pesticides by EPA method 8141;
- PCBs by EPA method 8082;
- Cyanide by EPA method 9010; and
- Sulfide by EPA method 9030.

### 5.4.2 Surface Water Sampling Results

Analytical results for surface water samples indicated that all organic constituents and almost all metals were less than MDE Cleanup Standards for Groundwater, the criteria used to screen surface water. The only constituent that exceeded the cleanup standard was cobalt at sampling location SW-3, with a concentration of 39 µg/L. The cleanup standard for cobalt is 1.1 µg/L.

See **Table 5-4** for a summary of constituents detected in surface water samples, compared to MDE Groundwater Cleanup Standards (MDE 2008). Complete data tables are included in **Appendix D**, and laboratory analytical reports for surface water samples are included in **Appendix H**.

### 5.4.3 Constituent Comparison to Historical Data

In addition to the surface water samples collected by EA in August 2010, the County collected samples from the five (5) original sampling locations in September 2010.

Historically, a few uncorrelated COCs have been occasionally reported at concentrations exceeding MDE Cleanup Standards for Groundwater in samples from locations ST065 and ST120 in Crabbs Branch. New surface water sampling locations SW-1 and SW-2 are located in Crabbs Branch upstream from these existing locations. No concentrations exceeding screening criteria were reported in samples from these four (4) locations in the 2010 sampling events.

Isolated exceedances of all four (4) surface water COCs have historically been reported at surface water sample locations ST015, ST70, and ST80, in the unnamed channel along the southern boundary of the site. Only bis(2-ethylhexyl)phthalate had historical exceedances on two (2) consecutive occasions, at ST70. New sample location SW-5 is located in the channel, between ST015 and ST70, and location SW-4 is located between ST70 and ST80. Concentrations of all COCs at these locations were less than screening criteria during the 2010 sampling events.

New sampling location SW-3 is located in a smaller drainage, northeast of the Landfill, that runs into Crabbs Branch. As described above, an exceedance of the MDE Cleanup Standard for Groundwater for cobalt was reported at this location in the August 2010 sampling.

## 5.5 SURFACE SOIL SAMPLING

### 5.5.1 Surface Soil Sampling Program

Eleven (11) surface soil grab samples were collected along the northern and western boundaries of the site to assess the condition of surface soil along the Derwood Station residential development property boundary, near the men’s shelter, and near the model airplane flying area. The locations are shown on **Figure 5-4**.

The samples were packed directly into the sample bottles provided by the analytical laboratory, labeled, and packed on ice. Surface soil samples from locations within the Derwood Station residential development were collected just beneath the grass cover. The grass cover was replaced following sample collection, such that the area of disturbance was not visible.

The surface soil samples were delivered to the laboratory under proper chain-of custody protocol for analysis of:

- VOCs by EPA Method 8260;
- SVOCs by EPA Method 8270;
- Metals by EPA Method 6020;
- Herbicides by EPA Method 8151;
- Chlorinated pesticides by EPA Method 8081;
- Organophosphate pesticides by EPA Method 8141;
- PCBs by EPA Method 8082;
- Cyanide by EPA Method 9010; and
- Sulfide by EPA Method 9030.

### 5.5.2 Surface Soil Sampling Results

Surface soil analytical results reported various metals exceeding MDE Residential Cleanup Standards for Soil at various sampling locations and one (1) detection of PCB Aroclor 1260 above MDE Residential Cleanup Standards for Soil, at location SS-3. As with the subsurface soil samples, all samples also had detections of arsenic, cobalt, and vanadium above the cleanup standards, and all samples except for SS-9 also had chromium concentrations above the cleanup standard. As discussed for subsurface soil, these appear to represent soil background concentrations (MDE 2008). See **Table 5-5** for a summary of constituents detected in surface soil samples. Complete data tables are included in **Appendix D**, and laboratory analytical reports for surface soil samples are included in **Appendix I**.

# 6. RISK EVALUATION

A risk evaluation was performed in accordance with MDE and EPA guidance (MDE 2008, EPA 2010, EPA 1989) to assess potential concerns for human health and ecological receptors and to evaluate if further assessment is warranted.

## 6.1 Conceptual Site Model

Conceptual site models (CSMs) are provided to identify exposure routes and potential receptors in the vicinity of the Landfill. Based upon the identified exposure routes and potential receptors, complete exposure pathways are determined for the risk evaluation. Exposure pathways link potential receptors (e.g., wildlife and humans) to constituents of concern detected at the Landfill. The CSMs are illustrated graphically as **Figures 6-1** and **6-2**. The CSMs identify:

- the primary source and release mechanisms for constituents of concern,
- the general distribution of these chemicals,
- the media of concern at the site,
- potential exposure pathways for ecological and human receptors, and
- potential wildlife receptors and human populations that could be exposed.

Only exposure pathways that are complete are included in the risk evaluation. An exposure pathway describes the mechanism by which a potential receptor contacts chemicals present at a site. A complete exposure pathway requires the following four (4) components:

1. a source and mechanism of chemical release to the environment,
2. an environmental transport medium for the released chemical,
3. a point of potential contact with a medium containing chemicals, and
4. an exposure route (e.g., ingestion or dermal absorption) at the point of exposure.

All four (4) components must exist for an exposure pathway to be complete and for exposure to occur. Incomplete exposure pathways do not result in actual exposure of receptors.

### 6.1.1 Historical Constituents of Concern

Based on historical data (2001-2009) collected from twenty (20) existing groundwater monitoring wells at the Landfill, VOCs are the primary constituents of concern. VOCs historically detected above the MCLs include: TCE, cis-1,2-dichloroethene, PCE, vinyl chloride, benzene, methylene chloride, and 1,2-dichloropropane. Historical data (2001-2009) for surface water have reported concentrations of TCE, cyanide, bis(2-ethylhexyl)phthalate, and methylene chloride above the MCLs.

### 6.1.2 Migration Pathways

Migration pathways were evaluated to determine complete exposure pathways in the risk evaluation. The primary onsite source for constituents of concern is the former waste disposal area of the Landfill. Waste was generally placed within the Landfill property boundary identified on **Figure 2-1**. Waste was placed beyond the property boundary along the M-NCPPC property boundary to the north and east of the Landfill, with the limit of waste extending approximately two hundred (200) to two hundred fifty (250) ft from the Landfill property boundary. In addition, surficial waste was found along limited portions of the northwestern (gas pipeline right-of-way) and southern (WSSC property) boundaries of the Landfill.

Infiltrating rainwater (and groundwater, if waste is in contact with groundwater) can become strongly acidic through biochemical and chemical reactions with the waste mass. This acidic water then leaches chemicals from the waste to form leachate. The leachate can then potentially migrate and impact groundwater. The volume of leachate generated and migrating from the Landfill depends upon such factors as surface conditions, volume of water percolating through the waste, refuse conditions, precipitation, and underlying soil and rock conditions. The Landfill has a minimum two (2)-ft-thick soil cap to limit direct contact of precipitation with waste; however, it does not have a synthetic liner or an engineered capping system to control the generation or migration of leachate. Therefore, leachate is produced and likely enters groundwater underlying the Landfill. Leachate may also seep out of the surface of the Landfill, particularly along side-slopes and at lower points in the Landfill where the slope significantly changes.

Leachate seeps can comingle with stormwater during rainfall events at the site. The stormwater runoff could then, if flow from the seeps is significant, convey leachate to nearby surface water bodies and potentially impact surface water quality. Stormwater runoff can also convey the leachate to flat or ponded areas where the leachate could potentially infiltrate into groundwater and impact groundwater quality. Surface water bodies in the vicinity of the Landfill include Crabbs Branch along the northeastern property boundary and Rock Creek east of the Landfill. Southlawn Branch and other un-named tributaries of Rock Creek are located south of Crabbs Branch and along the southern property boundary.

The Landfill is underlain by crystalline rock that is overlain by the unconsolidated sediments consisting of interbedded silts and clays and saprolite. Groundwater movement in the unconsolidated zone occurs more readily than in the underlying bedrock and is highly dependent on the composition and grain size of the sediments. Groundwater is present along the perimeter of the Landfill at depths ranging from zero (0) to sixty (60) ft bgs. Groundwater recharge at the Landfill is variable and is primarily determined by precipitation and runoff. Infiltrating water likely moves laterally through the unconsolidated layer on the surface of the bedrock and discharges to nearby streams. The groundwater discharge to surface water bodies is another potential migration pathway for the Landfill.

Groundwater elevation data suggests that a minor radial flow component to the north exists along the northwest landfill boundary, in the vicinity of MW-7 and MW-8. Groundwater flow in this direction from the landfill presents a potential migration pathway for constituents of concern to migrate with the natural groundwater gradient from the landfill to the adjacent Derwood Station residential development.

**<u>Human Health Receptors and Exposure Pathways</u>**

The exposure pathways for human health are summarized in **Figure 6-1**. Potential human receptors are identified based on the current use of the Landfill property and adjacent properties and potential migration pathways. The Landfill property consists of approximately one hundred sixty-two (162) acres. The surrounding area is mixed use, bounded to the south by industrial operations, to the west/northwest by the Derwood Station residential development, and to the north and east by M-NCPPC property. Major site features include a paved area and road in the vicinity of a former incinerator in the southeastern portion of the Landfill; a model airplane flying area in the northern portion of the Landfill; and a landfill gas-to-energy plant and flare station, and men's shelter in the southwest corner of the property.

Potential receptors for the Landfill include recreational users, County employees or contractors who maintain the Landfill, and residents of the men's shelter. Recreational users are primarily residents of Derwood Station who would visit the areas adjacent to the Landfill property and the grassy areas of the Landfill for walking trails and use of the model airplane flying area. The recreational users also may contact surface water located within the streams located adjacent to the Landfill. Recreational users are assumed to contact only surface media, including surface soil and surface water. Recreational users typically do not dig to depths greater than two (2) ft and are not expected to contact subsurface soil and groundwater. Residents of the men's shelter are expected to have exposure pathways similar to the recreational user since residence at the shelter is a temporary basis. Residents of the men's shelter are not expected to contact surface water near the Landfill. County employees and contractors are assumed to work at and maintain the Landfill. These employees may perform various activities that may include digging, various landscaping, and maintenance of the Landfill facility. As a result, County employees and contractors are expected to contact surface soil and subsurface soil.

Based upon the groundwater flow gradients, the residents within Derwood Station are potential receptors. Groundwater is not used as a potable water supply in the area. Potable water is supplied by the WSSC, which maintains an intake on the Potomac River. Additionally, the installation of potable or other wells are not permitted within the WSSC service area. Therefore, residential use of groundwater as a tap water source is not a complete exposure pathway. However, VOCs are historical constituents of concern within groundwater. There is a potential for VOCs in groundwater to migrate into basements or other structures through vapor intrusion. This exposure pathway is considered complete for the residents in Derwood Station and residents of the men's shelter. Therefore, further risk evaluation was completed for this pathway.

**Ecological Receptors and Exposure Pathways**

The exposure pathways for the ecological receptors are summarized in **Figure 6-2**. Surface soil and surface water represent the media to which ecological receptors are potentially exposed. Direct exposure to surface soil by terrestrial plants and soil invertebrates (e.g., earthworms) represents a complete exposure pathway. Terrestrial birds and mammals are exposed to contaminants by the consumption of surface soil, or indirectly by dermal contact with the soil, although this latter exposure is small due to the presence of feathers or hair on these animals.

Aquatic organisms, birds, and mammals have direct exposure to contaminants by the ingestion of and direct contact with surface water; consequently, this is considered a complete exposure pathway. The direct contact with surface water by birds and mammals represents a complete pathway; however, risks from this exposure are small relative to ingestion (EPA 2005).

Finally terrestrial birds and mammals have a complete pathway to prey/vegetation that are consumed as part of the food chain. Prey/vegetation may bioaccumulate contaminants, and, for selected chemicals, may biomagnify into birds and mammals that consume the prey/vegetation.

### 6.1.3 Data Quality Evaluation

Data evaluated in this risk evaluation were collected as part of the Nature and Extent Study during July and September 2010. Historical sample results are not included in the risk evaluation. As part of the Nature and Extent Study, samples were collected from surface soil, subsurface soil, groundwater, and surface water. Surface soil samples were collected at locations to assess the condition of surface soil along the Derwood Station residential development property boundary, near the men's shelter on the Landfill property, and near the model airplane flying area. A total of eleven (11) surface soil samples were collected. Sixteen (16) additional groundwater monitoring wells were installed based on a review of historical groundwater analytical data and the data gaps identified in the existing monitoring well network. Proposed groundwater monitoring well depths were designed to evaluate groundwater concentrations at several intervals of potential impact starting at the perimeter of the Landfill and working out (away from the perimeter). Shallow/deep well pairs were installed in areas where there was no existing data and shallow wells were installed in areas where shallow groundwater data was not available from existing deep monitoring wells. After the installation and development of the monitoring wells, groundwater sampling was conducted at the sixteen (16) new and twenty (20) existing groundwater monitoring wells. In addition, a subsurface soil sample was collected from each boring where new monitoring wells were installed. Ten (10) surface water samples, from five (5) existing surface water sampling locations and five (5) new surface water sampling locations, were collected from offsite streams around the perimeter of the Landfill.

Sample results were evaluated to determine the data quality for use in the risk evaluation. Data quality is assessed through the use of analytical qualifiers. The decision to include or exclude data on the basis of analytical qualifiers is performed in accordance with EPA guidance (EPA 1989). The following data qualifiers are applicable to this risk evaluation:

- Analytical results bearing the U or UJ qualifier (indicating that the analyte is not detected at the given sample quantitation level [SQL]) are retained in the data set and considered non-detects. Where warranted for statistical purposes, each analytical result is assigned a numerical value equal to its SQL.

- Analytical results bearing the J qualifier (indicating that the reported value is estimated because the analyte is detected at a concentration below the SQL or for other reasons), E qualifier (indicating that the reported value is estimated because of presence of interference), and B qualifier (indicating that the analyte was identified in the method blank) are retained at the measured concentration.

For duplicate samples collected or duplicate analyses conducted on a single sample, the following guidelines are employed to select the appropriate sample measurement:

- If both samples/analyses show that the analyte is present, the average of the two (2) detected concentrations is retained for analysis, based on conservative professional judgment;

- If both samples/analyses are not detected, the average of the two (2) non-detect concentrations is retained for analysis; and

- If only one (1) sample/analysis indicated that the analyte is present, it is retained for analysis and the non-detect value is discarded.

### 6.1.4 Human Health Risk Evaluation

As part of this risk evaluation, a hazard assessment is conducted to determine chemicals detected in sample results that exceed human health-based screening values. Chemicals above the human health-based screening values are considered constituents of potential concern (COPCs). The hazard assessment takes into account the complete exposure pathways identified in the CSM when completing the screening. The following sections summarize the hazard assessment and provide a discussion of COPCs reported in concentrations exceeding health-based screening values.

#### 6.1.4.1 Human Health-Based Screening Methods

For the human health screening, the maximum detected concentrations in all media are compared to the MDE Cleanup Standards for Soil and Groundwater (MDE 2008), which are the State's primary human health screening values. For analytes not listed in the MDE guidance, the EPA Regional Screening Levels (RSLs) (EPA 2010) are used for screening. The MDE Cleanup Standards for Soil are selected from the highest value from the EPA Region 3 Risk-Based Concentration (RBC) or the practical quantitation limit (PQL) of laboratory instrumentation. The MDE groundwater cleanup standard is selected as either the MCL, the Secondary Drinking Water Regulation for an analyte, or the highest of the EPA Region 3 tap water RBC and the PQL of laboratory instrumentation. The EPA RBCs and RSLs are based on specific, conservative, fixed levels of potential human risk. For carcinogens, this risk level is $10^{-6}$, which is the lower bound for potential acceptable carcinogenic risk as defined by the National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1990). For non-carcinogens, the RSLs are based on a hazard quotient (HQ) of one (1.0). Per EPA Region 3 guidance (EPA 1993), one-tenth ($1/10^{th}$) of the RSL for non-carcinogens is used. The MDE cleanup standards for non-carcinogens take into account the one-tenth ($1/10^{th}$) reduction. These fixed risk levels are conservative to account for potential additivity or cumulative effects of multiple chemicals.

If the maximum detected concentration is less than the analyte-specific MDE cleanup standard (MDE 2008) (or RSL if no MDE standard is available), the chemical is eliminated from further consideration for that medium. If the maximum concentration is reported at concentrations exceeding the MDE cleanup standard, the chemical is retained for further evaluation as a COPC. Some analytes detected at the site are evaluated via surrogates, which are chemicals with similar chemical composition or toxicity. Any surrogates used in the screening are indicated in the screening tables.

As noted previously, current receptors include recreational users, County employees, residents of the men's shelter, and residents living in an adjacent community. The screening evaluates potential human exposure based upon medium- and receptor-specific screening criteria. For the recreational user and residents of the men's shelter, soil concentrations are compared to the MDE residential cleanup standards for soil. The use of residential cleanup standards for the recreational user and residents of the men's shelter is a conservative screening approach. These receptors are not expected to live in the locations where soil samples were collected. Furthermore, these receptors are not expected to dig or have prolonged contact with soils. The use of residential cleanup standards ensures the screening effectively evaluates any potential concerns for the recreational user and residents of the men's shelter. For County workers and contractors (i.e., maintenance worker, commercial worker, construction worker), soil concentrations are compared to the MDE non-residential cleanup standard. For groundwater and surface water, maximum concentrations are compared to the MDE groundwater standards for Type I and II aquifers. The use of the groundwater standards for screening groundwater and surface water is a conservative measure. The groundwater standards assume the water source is used as a primary potable water supply for drinking, bathing, and cooking a total of three hundred fifty (350) days per year for thirty (30) years. Groundwater and surface water are not used in this manner in the vicinity of the Landfill. However, this provides a precautionary screen for these media.

#### 6.1.4.2 Human Health Risk Screening Results

The occurrence, distribution, and selection of analytes in each medium are represented in **Tables 6-1 through 6-7** following the EPA's Risk Assessment Guidance for Superfund (RAGS)

D format (EPA 2002b). These tables are receptor-specific and present the minimum and maximum detected concentrations, the location of the maximum detected concentrations, as well as the frequency of detection (FOD) for each chemical detected. Analytes that exceed screening criteria are presented in bold type.

For metals, **Tables 6-1 through 6-4** present the ATC values (MDE 2008). The ATC represents a reference level for metals and trace elements in Maryland soils in the natural environment absent from anthropogenic effects (MDE 2008). Chemicals are not eliminated from consideration in the risk screen based upon the ATC; results of the comparison are used to discuss COPCs in Section 6.1.5.

**Surface Soil**

The following COPCs in surface soil – residential (**Table 6-1**) are identified based on the MDE residential cleanup standard: arsenic, chromium, cobalt, vanadium, and Aroclor-1260.

The following COPCs in surface soil – non-residential (**Table 6-2**) are identified based on the MDE non-residential cleanup standard: arsenic, cobalt, vanadium, and Aroclor-1260.

**Subsurface Soil**

The following COPCs in subsurface soil – residential (**Table 6-3**) are identified based on the MDE residential cleanup standard: arsenic, chromium, cobalt, vanadium, and Aroclor-1254.

The following COPCs in subsurface soil – non-residential (**Table 6-4**) are identified based on the MDE non-residential cleanup standard: arsenic, cobalt, and Aroclor-1254.

**Surface Water**

Only one (1) surface water COPC (**Table 6-5**) is identified based on the comparison to the MDE groundwater standards: cobalt.

**Groundwater**

Groundwater is evaluated based on two (2) separate exposure pathways. Groundwater sample results from monitoring wells within the Derwood Station residential development are evaluated as one exposure area. The remaining groundwater sample results from monitoring wells within the Landfill property and the adjacent M-NCPPC property are combined and evaluated as a second exposure area.

**<u>Groundwater − Gude Landfill</u>**

The following groundwater COPCs (**Table 6-6**) are identified based on the comparison to MDE groundwater standards: arsenic, beryllium, cadmium, chromium, cobalt, lead, mercury, nickel, vanadium, 1,2-dichloropropane, benzene, cis-1,2-dichloroethene, hexachlorobutadiene, methylene chloride, naphthalene, PCE, TCE, and vinyl chloride.

**<u>Groundwater − Derwood Station</u>**

The following groundwater COPCs (**Table 6-7**) are identified based on the comparison to MDE groundwater standards: chromium, cobalt, lead, nickel, vanadium, and PCE.

### 6.1.5 Human Health Risk Evaluation Results

The purpose of the human health risk evaluation is to provide information regarding the COPCs at the Landfill and to evaluate whether further assessment is warranted. COPCs within each medium are discussed below.

#### 6.1.5.1 Soil (Surface and Subsurface)

Surface soil is a complete exposure pathway for recreational users, County workers, and residents of the men’s shelter at the Landfill. Subsurface soil is a potential complete exposure pathway for residents within Derwood Station or County workers/contractors at all areas. Subsurface soil samples were collected during the installation of sixteen (16) new groundwater monitoring wells. The subsurface soil samples were collected from depths greater than two (2) ft bgs, with a majority of the samples collected at depths greater than ten (10) ft bgs. Therefore, any resident exposure to subsurface soil would occur only during excavation activities, not during typical gardening and landscaping activities. In addition, residents within Derwood Station would only be exposed to subsurface soil in the vicinity of monitoring wells MW-9, MW-10, MW-11A, MW-11B, and MW-12. All subsurface soil sample results are compared to residential cleanup standards as a conservative measure.

**Metals**

Similar COPCs are determined for both surface and subsurface soil: arsenic, chromium, cobalt, and vanadium. Maximum detected concentrations of metals in soil are comparable to the Maryland ATC concentrations and are within an order of magnitude of the MDE cleanup standards. In addition, the metals detected and their concentrations are consistent between surface and subsurface soil, which indicates that they are primarily naturally occurring and do not pose a concern for human health.

**PCBs (Aroclor 1254 and 1260)**

Two (2) PCBs (Aroclors) were detected in soil. Aroclor 1260 is considered a COPC in surface soil and Aroclor 1254 is considered a COPC in subsurface soil. The PCBs are only detected once in each medium, indicating that they are not likely a site-wide concern. In surface soil, Aroclor 1260, at sample location SS-3, is less than an order of magnitude greater than the MDE residential and non-residential soil cleanup standards. For subsurface soil, Aroclor 1254, at sample location MW-4, is also less than an order of magnitude greater than the MDE residential and non-residential soil cleanup standards. Therefore, the Aroclor detections do not exceed the MDE remedial action standard of $10^{-5}$. Additionally, sample location SS-3 is located within the M-NCPPC property, in an area used for recreational purposes. Sample location MW-4 is located within the Landfill property, which will not be used for residential purposes. The comparison to residential cleanup standards is conservative and overestimates potential human exposure in these areas. Therefore, the detections of Aroclor 1260 in surface soil and Aroclor 1254 in subsurface soil do not represent a concern for human health.

#### 6.1.5.2 Groundwater

Groundwater monitoring well sample results are evaluated as two (2) separate data sets: results from locations within the Derwood Station residential development, and all other Gude Landfill monitoring well results. The risk-based screening results presented in **Tables 6-6 and 6-7** are based upon the use of groundwater as a tap water source. This is an incomplete exposure pathway for groundwater for the area surrounding the Landfill, as shown on **Figure 6-1**. The only complete exposure pathway for groundwater is potential vapor intrusion of VOCs from groundwater into indoor air. Three (3) VOCs, dichlorodifluoromethane, TCE, and PCE, were reported in samples collected from the Derwood Station groundwater monitoring wells. For the men's shelter, the closest monitoring wells are MW-6 and OB01. MW-6 has the highest concentrations of VOCs; therefore, this monitoring well is used for in the assessment of vapor intrusion into the men's shelter. The vapor intrusion pathway is evaluated further through the use of the Johnson and Ettinger (J&E) Model for Subsurface Vapor Intrusion into Buildings (EPA 2004).

For the J&E Model, the maximum detected concentrations of VOCs, the depth to groundwater at MW-9 (sixteen and a half [16.5] ft bgs for Derwood Station) and MW-6 (sixteen [16] ft bgs for the men's shelter), and the prevalent Soil Conservation Service soil type from boring logs were used as inputs to the model. The results of the J&E Model are provided in **Appendix J**. The J&E Model indicates that carcinogenic risks and non-carcinogenic hazards are well below levels of concern identified by MDE.

#### 6.1.5.3 Surface Water

Cobalt is the only COPC identified in surface water. Several VOCs (PCE, TCE, and cis-1,2-dichloroethene) were reported in the sample collected from SW1, but concentrations are less than the MDE cleanup standards for groundwater. Cobalt is not considered a concern for human health based upon the infrequent contact with surface water.

### 6.1.6 Ecological Risk Evaluation

#### 6.1.6.1 Ecological Screening and Identification of COPCs

The most conservative risk screening values designed for the protection of the ecological receptors discussed above are obtained from EcoSSLs (http://www.epa.gov/ecotox/ecossl/) or the scientific literature for soil. EPA Region 3 BTAG risk screening values (EPA 2006) are used for surface water consistent with EPA Region 3 guidance (http://www.epa.gov/reg3hwmd/risk /eco/faqs/screenbench.htm, accessed October 2010). These values are included in **Table 6-8**, along with the sources of the values and any appropriate comments.

The selection of COPCs is made by establishing the HQ. The HQ is defined as:

$$HQ = \text{Maximum Detected Concentration/Screening Value}$$

If the HQ is greater than one (1.0) there is a potential that the contaminant may negatively affect the ecological receptor, and the contaminant is designated a COPC. The selection of COPCs in surface soil and surface water based on HQs greater than one (1.0) are shown in **Table 6-9**.

COPCs identified for surface soil include seven (7) metals (chromium (HQ = 2.1), cobalt (HQ= 3.1)], copper (HQ = 2.2), lead (HQ = 2.8), nickel (HQ = 1.7), vanadium (HQ = 28), zinc (HQ =

2.2)) and high molecular weight polycyclic aromatic hydrocarbons (HPAHs), defined as having four [4] or more aromatic rings) with an HQ of 1.1.

COPCs identified for surface water include barium (HQ = 58), cobalt (HQ = 1.7) and nickel (HQ = 1.1). No screening values were found for the volatile organics chloromethane or dichlorodifluoromethane; however, measured concentrations of these chemicals are very small (0.8 µg/L), and they are detected in only one (1) or two (2) of the fifteen (15) surface water samples. The relatively large screening values for other volatile organics (1.3-14,000 µg/L) also indicate that VOCs are not generally very toxic to aquatic organisms, and these two (2) VOCs are therefore also not expected to be very toxic. Consequently, identification of chloromethane and dichlorodifluoromethane as COPCs is not appropriate.

The potential risks associated with exposure to the identified surface water COPCs (barium, cobalt, and nickel) are discussed in greater detail below.

#### 6.1.6.2 Ecological Risk Screening Results

The identification of a chemical or metal as a COPC does not necessarily mean that the specific ecological receptor populations are at risk. The screening values shown in **Table 6-8** are designed to be conservative, such that sites that may present risks to ecological receptors are not missed. The perceived risk is discussed in detail below based on each of the two (2) media (surface soil and surface water).

**Surface Soil Risk**

Seven (7) metals (chromium, cobalt, copper, lead, nickel, vanadium, and zinc) are identified as COPCs in surface soil (**Table 6-9**). In addition, HPAHs are identified as a COPC. A summary of data for these metals is included in **Table 6-10**. The following text addresses these identified COPCs.

Reported nickel concentrations exceeded the screening value of 38 mg/kg in one (1) out of eleven (11) samples. The HQ for the single sample that exceeded the screening value is 1.1 mg/kg. Consequently, it is not expected that populations of ecological receptors are at risk from exposure to nickel in surface soil at the Landfill.

Reported chromium, cobalt, copper, lead, vanadium, and zinc concentrations exceeded risk screening values in the majority of samples taken, indicative of site-wide conditions. Further, these metal concentrations tended to exceed Central Maryland background (ATC) concentrations (MDE 2008). The surface soil samples are primarily located in the pipeline right-of-way, and measured concentrations for these metals are consistent for all sample locations, slightly exceed risk screening values, and are slightly higher than background or reference concentrations indicates that they represent localized reference. As a result, the metals in surface soils in this area, along the northwestern boundary of the site, do not represent risk to ecological receptors.

High-molecular-weight PAHs slightly exceeded the ecological risk screening value with an HQ of 1.1; however, reported concentrations in surface soil are consistent and are reported at or near the detection limit. This is indicative of background conditions that represent a ubiquitous atmospheric deposition of PAH, not consistent with release from the site. As a result, the reported concentrations of high-molecular-weight PAHs are unlikely to represent unacceptable risk to populations of ecological receptors.

**Surface Water Risk**

Three (3) metals are identified as COPC in surface water: barium, cobalt, and nickel (**Table 6-8**). Surface water sample SW-3, located to the north-northeast of the Landfill, is the location of highest concentrations of these metals, often by more than an order of magnitude. Risk screening values for cobalt and nickel are only exceeded in that specific sample, and all reported concentrations for other surface water sampling sites are at or below the risk screening value for these metals. In addition, the magnitudes of the HQs at SW-3 for cobalt and nickel are small (1.7 and 1.1 respectively). Consequently, it is not expected that populations of ecological receptors are at risk from exposure to cobalt and nickel. The risk screening value of four (4) µg/L for barium is exceeded in all samples, although the concentration at SW-3 (230 µg/L) is significantly higher than the concentrations reported in the other surface water samples (35-60 µg/L). The source of the barium ecological screening value is an Oak Ridge National Laboratory document (Suter and Tsao 1996); however, the original source was an earlier Oak Ridge National Laboratory document, Suter and Mabrey (1994) which is no longer available. Consequently, it is impossible to verify the veracity of the 4 µg/L screening value. It is known that there are few aquatic toxicological data available for barium in surface water. Given the lack of definitive aquatic toxicological data to support the 4 µg/L screening value and the skewed barium concentrations found only at SW-3, it is not likely that aquatic receptors are at risk from exposure to barium in surface water.

### 6.1.7 Conclusions

The risk evaluation assessed potential human and ecological receptors’ contact with soil, surface water, and groundwater potentially impacted by the Landfill. COPCs are identified for potential human receptors exposure to soil, surface water, and groundwater. Within surface and subsurface soil, similar metal COPCs are identified. The maximum detected concentrations of metals in soil are comparable to the Maryland ATC concentrations and are within an order of magnitude of the MDE cleanup standards. In addition, the COPCs and their concentrations are consistent between surface and subsurface soil, which indicates that the metals are primarily naturally occurring and do not pose a concern for human health. Two (2) PCBs (Aroclors) were detected in soil. Aroclor 1260 is considered a COPC in surface soil and Aroclor 1254 is considered a COPC in subsurface soil. The PCBs are only detected once, indicating that they are not a site-wide concern. Both detections are less than an order of magnitude greater than the MDE residential and non-residential soil cleanup standards. Additionally, sample location SS-3 is located within the M-NCPPC property, in an area used for recreational purposes. Sample location MW-4 is located within the Landfill property, which will not be used for residential purposes. The comparison to residential cleanup standards is conservative and overestimates any human exposure that is expected in these areas. Therefore, the detection of Aroclor 1260 in surface soil and Aroclor 1254 in subsurface soil is not likely to result in human health concerns. For groundwater, the only complete exposure pathway is vapor intrusion of VOCs to indoor air. The risk evaluation did not indicate concerns with this potential exposure pathway. Within surface water, only one (1) COPC is identified: cobalt. The detection of cobalt does not represent a concern for human health contact.

Potentially complete pathways between ecological receptors, including terrestrial and aquatic organisms, and surface soil and surface water are identified. Seven (7) metals and HPAHs are identified as COPCs in surface soil. However, once background conditions and the magnitude of exceedance of screening values are evaluated, it is likely that the concentrations of COPCs represent reference or natural conditions. Therefore, the populations of terrestrial receptors exposed to these COPCs are not at risk. Three (3) metals are identified as COPCs in surface water. Reported concentrations of these three (3) metals that exceed MDE cleanup standards are limited to a single location, and populations of aquatic organisms exposed to these COPCs are not at risk.

The only complete human health exposure pathway for contact with groundwater is the inhalation of VOCs within indoor air (i.e., basements, crawl spaces). The indoor air pathway was evaluated through the use of the Johnson and Ettinger Model (EPA 2004) and there are no concerns for human health based upon reported concentrations. The Johnson and Ettinger Model was also used to calculate groundwater VOC concentrations that would require additional investigation of groundwater within the Derwood Station community and potential human exposure in a human health risk assessment. Groundwater VOC concentrations were calculated for the seven (7) historical VOC COCs: benzene, cis-1,2-dichloroethene, 1,2-dichloropropane, methylene chloride, PCE, TCE, and vinyl chloride. The modeled groundwater VOC concentrations that would require further screening, the maximum reported groundwater VOC concentrations, and the Johnson and Ettinger Model calculations are provided in **Appendix J**. The modeled groundwater VOC concentrations are significantly higher than the reported VOC concentrations within the Derwood Station community. Only two (2) of the historical VOC COCs were detected within the Derwood Station community, PCE and TCE. This further indicates that human exposure to complete groundwater exposure pathways is not a concern for residents of the Derwood Station community.

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# 7. SUMMARY OF FINDINGS

As directed by MDE, the Montgomery County DEP conducted this Nature and Extent Study to delineate the nature and extent of waste and environmental impacts in the vicinity of and potentially resulting from the Landfill. This study provides information that will assist Montgomery County with assessment and remediation planning for the Landfill. The purpose of the assessment activities at the Landfill was to characterize the nature and extent of potential soil, groundwater, and surface water impacts from former Landfill operations and from the Landfill as it exists today.

The waste delineation study, conducted in 2009, confirmed that waste was generally placed within the Landfill property boundary with the exception of the areas along the northeastern landfill boundary. Along this boundary, waste was identified two hundred (200) to two hundred fifty (250) ft northeast of the northeastern property boundary, on M-NCPPC property.

Surface soil, subsurface soil, surface water, and groundwater samples were collected as part of this Nature and Extent Study. COCs were reported at concentrations exceeding MCLs and MDE cleanup standards. For areas where historical locations were re-sampled, the data were of consistent magnitude with historical sampling results.

Groundwater elevation data collected during the Nature and Extent Study indicates easterly and southerly flow, with minor flow components to the north and northeast in the northern portions of the site. These components appear to reflect a radial groundwater flow regime around the edges of the Landfill, which is consistent with variability in topography, surface recharge, and potential mounding of water within the waste mass created by the former landfill. The groundwater analytical data indicate that the greatest concentrations of COCs are located along the north-northwestern and south-central boundaries of the Landfill. Generally, COC concentrations, except vinyl chloride, were below MCLs in the southwest, southeast, and northeast portions of the site. Analytical data indicate that the impacts present in the OB03 well pair extend north to MW-13A and MW-13B, rather than west toward the Derwood Station development.

Analytical results for surface water samples collected during the Nature and Extent Study indicated that all organic constituents and all metals (with the exception of cobalt) were less than MDE Cleanup Standards for Groundwater. The concentration of cobalt at sampling location SW-3 (39 µg/L) exceeded the cleanup standard (1.1 µg/L).

Subsurface soil samples were collected from the boreholes at the sixteen (16) groundwater monitoring wells installed as part of the Nature and Extent Study. Arsenic, chromium, cobalt, and vanadium were reported at concentrations exceeding MDE Residential Cleanup Standards for Soil at all soil boring locations. The consistency of reported metal concentrations in soil samples across the site is indicative of background soil metal concentrations published by MDE (2008). In one (1) sample, taken at two (2) to four (4) ft bgs in the boring at MW-04, the reported concentration of PCB Aroclor 1254 (1.7 mg/kg) exceeded the MDE Residential Cleanup Standard for Soil (0.32 mg/kg).

Arsenic, chromium, cobalt, and vanadium were also reported at concentrations exceeding MDE Residential Cleanup Standards for Soil in the surface soil samples from locations along the northeastern boundary of the site. PCB Aroclor 1260 was detected above MDE Residential Cleanup Standards for Soil at location SS-3. Generally, reported concentrations in surface soil samples did not exceed the residential soil cleanup standards for any constituents other than metals, which were consistent with background levels published by MDE (2008).

As part of the Nature and Extent Study, human health and ecological risk evaluations were conducted to assess potential human and ecological receptor contact with soil (surface and subsurface), surface water, and groundwater potentially impacted by the Landfill. Potentially complete exposure pathways were identified for all four (4) media in the human health risk evaluation, and for surface soil and surface water in the ecological risk evaluation. Additional risk evaluation was performed for complete exposure pathways only, since no risk can result from an incomplete pathway.

No human health concerns related to contact with surface water or soils, or related to indoor air inhalation following vapor intrusion from groundwater, were identified. The only potential human health concern identified related to groundwater would arise if the aquifer were used as a potable water supply, currently an incomplete exposure pathway. The installation of potable water supply wells is prohibited, since water is supplied by WSSC. For surface and subsurface soils, reported metals concentrations are consistent with MDE-published background levels, and do not present human health concerns. The isolated detections of PCBs in surface and subsurface soils indicate that there is not a site-wide PCB concern and that PCBs in soil are not likely to result in human health concerns at the site.

Potentially complete pathways between ecological receptors, including terrestrial and aquatic organisms, and surface soil and surface water are identified. As with human health risk evaluation, the ecological risk evaluation found that terrestrial receptors exposed to surface soils are not at risk, because the metal and HPAH COPCs in surface soil represent reference or natural conditions. Isolated occurrences of metals at concentrations exceeding MDE cleanup standards in surface water also do not present a risk to populations of aquatic organisms.

The primary findings of this study include the following:

- Groundwater flow around the Landfill is to the east and south, with minor flow components to the north and northeast in the northern portions of the site.

- Consistent with historical reports, the highest VOC concentrations in groundwater were reported for samples collected along the north-northwestern and south-central boundaries of the Landfill.

- One (1) exceedance of MDE Cleanup Standards for Groundwater was reported in surface water, for cobalt, in a small drainage area northeast of the Landfill. This single isolated exceedance is consistent with the occasional, isolated exceedances reported during historical surface water sampling events.

- The reported concentrations of arsenic, chromium, cobalt, and vanadium exceeded MDE Residential Cleanup Standards for Soil, but are consistent with typical background concentrations published by MDE. Two (2) PCB exceedances were also reported, one (1) each in the surface and subsurface soils.

- The only potential human health concern identified related to groundwater would arise if the aquifer were used as a potable water supply; however, this is currently an incomplete exposure pathway due to the availability of a public water supply in nearby communities.

- The isolated detections of PCBs in surface and subsurface soils indicate that there is not a site-wide PCB concern and that PCBs in soil are not likely to result in human health concerns at the site.

- For surface and subsurface soils, reported metals and HPAH concentrations are consistent with reference concentrations or MDE-published background levels, and do not present ecological or human health concerns.

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